Macro Expectations, Aggregate Uncertainty, and Expected Term Premia*

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May 4, 2011

*We would like to thank Nicole Branger, Paul Carillo, Marcus Kappler, Kajal Lahiri, Juan Pablo Medina, Hashem Pesaran, Peter Norman Sørensen, Xuguang Sheng, as well as participants at the European Economic Association's Annual Meeting 2010, the German Finance Association's Annual Meeting 2010, the ZEW 2010 workshop on "Expectations and Expectation Formation in Financial Markets", and the ZEW 2010 conference on "Recent Developments in Macroeconomics" for helpful comments. Schmeling gratefully acknowledges support by the German Research Foundation (DFG) and Schrimpf appreciates support from the Center for Research in Econometric Analysis of Time Series, CREATES, funded by The Danish National Research Foundation. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Bank for International Settlements.

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Abstract

Based on individual expectations from the Survey of Professional Forecasters, we construct a real-time proxy for expected term premium changes on long-term bonds. We empirically investigate the relation of these bond term premium expectations with expectations about key macroeconomic variables as well as aggregate macroeconomic uncertainty at the level of individual forecasters. We find that expected term premia are (i) time-varying and reasonably persistent, (ii) strongly related to expectations about future output growth, and (iii) affected by uncertainty about future output growth and inflation rates. Expectations about real macroeconomic variables clearly matter more than expectations about nominal factors. Additional findings on term structure factors suggest that the level and slope factor capture information related to uncertainty about real and nominal macroeconomic prospects, and that curvature is closely related to subjective term premium expectations themselves. Finally, an aggregate measure of forecasters' term premium expectations has predictive power for bond excess returns over horizons of up to one year.

JEL-Classification: E43, E44, G12

Keywords: Bond Yields, Expectations Hypothesis, Time-varying Risk Premia, Term Premia, Aggregate Uncertainty

1 Introduction

Using panel data from the Survey of Professional Forecasters (SPF), we construct a simple proxy of forecaster-specific expectations about changes in future term premia which are basically equivalent to expected bond excess returns.[1] These term premium expectations are not estimated, are available in real-time, clearly time-varying, and reasonably persistent. We then employ a dynamic panel regression framework to investigate macro determinants of these term premium expectations at the level of individual forecasters. Our results indicate that individual term premium expectations are most strongly influenced by *expectations* about real GDP growth and a measure of aggregate uncertainty about future real macro conditions. Inflation expectations and aggregate inflation uncertainty are also important, but are dominated by real factors. Finally, an aggregate measure of term premium expectations across forecasters has predictive power for future bond excess returns over forecast horizons of up to one year.

There is ample evidence that the expectations hypothesis of the term structure of interest rates does not hold empirically and that investors tend to demand a compensation for holding long-term bonds. These term premia – or bond risk premia – compensate investors for higher risk and drive a wedge between short rates controlled by the central bank and longer-maturity rates. Since the latter are crucial for spending and investment decisions in the economy, term premia are relevant in many branches of macroeconomics and finance and the literature has convincingly demonstrated that term premia are time-varying (see e.g. Cochrane and Piazzesi, 2005; Ludvigson and Ng, 2009) and at least partly driven by the state of the business cycle. As this adds complexity to the conduct of monetary policy as well as investment and borrowing decisions of the private and public sector, an active field of research is devoted to a better understanding of time-varying risk premia in bond markets (see e.g. Ang and Piazzesi, 2003; Rudebusch, 2010; Wright, 2009).

This paper contributes to the strand of literature linking macroeconomic information to bond yields and bond risk premia. While existing studies in this literature typically investigate aggregate term premium estimates, we focus on survey-based term premium expectations at the level of *individual*

[1] To be precise at this initial stage already, the relation between our proxy of expected term premium changes and expected future bond excess returns is almost a 1:1 negative relationship. Rising investors' expectations about term premia in the future are associated with lower expected bond prices in the future, i.e. lower expected bond returns from today's perspective.

forecasters. This approach has two advantages: First, relying on survey information allows us to focus on the role of forward-looking macro *expectations* to understand term premia, whereas most earlier papers focus on the impact of *current* macro conditions.[2] Second, the forecasters in our panel naturally differ in their expectations about future macro conditions and term premia. We can exploit this cross-sectional variation to obtain more powerful tests when analyzing determinants of bond risk premia. Unlike in aggregate data where cross-sectional differences in expectations are washed out,[3] individual data allow us to identify stable relationships between macro expectations and term premia in the cross-section of forecasters. The explicit focus on forward-looking macro variables and the use of individual real-time expectations is a novel aspect of our analysis compared to earlier literature.

Relative to pure time-series analyses of bond risk premia where future bond returns are regressed on current macro variables (e.g. Ludvigson and Ng, 2009) or other bond predictors (e.g. Cochrane and Piazzesi, 2005), our survey approach has the advantage that it delivers an *observable* proxy for changes in term premium expectations and, equivalently, expected excess returns (available in real-time). Hence, we do not have to estimate expected returns, i.e. term premia, from noisy actual return data, which facilitates the detection of potential links between macro variables and bond risk premia.

Our main interest lies in the relation of term premia with expected future key macro business cycle variables - output growth and inflation - and aggregate uncertainty about these macro factors. Thus, in our benchmark specification, we regress individual term premium expectations on individual expectations about future real GDP growth and inflation (and instrument for these contemporaneous macro expectations) and measures of aggregate GDP and inflation uncertainty while controlling for lagged individual term premium expectations and further variables. As noted above, we find that nominal factors (expected inflation and inflation uncertainty) do matter for term premia to some extent, but that real factors (expected output growth and uncertainty about future output growth) clearly dominate the nominal factors. The main relations are such that higher expectations about output growth imply rising term premium expectations in the future, which is equivalent to lower expected bond returns. This result makes sense from a standard asset pricing perspective where good

[2]One exception is Chun (2011) who also studies the impact of macro expectations on term premia. However, Chun works at the aggregate level and does not study a panel of forecasters.

[3]For instance, consider the extreme case of only two investors where one forecaster expects a rise in the inflation rate of +2% and rising term premium of 1% and the other expects a decline in the inflation rate of -2% and a declining term premium of -1%. A panel regression will easily identify a positive relation between inflation expectations and term premia, whereas an aggregate analysis, relying on cross-sectional averages, will have little power to detect a significant relation since average inflation and term premium expectations will be equal to zero.

states of nature are associated with low risk premia. Likewise, higher aggregate uncertainty also leads forecasters to expect lower excess returns, which seems well in line with a flight-to-quality effect for U.S. treasury bonds in times of high macro uncertainty.

Our results confirm findings from earlier papers which show that output growth and/or inflation matter for risk premia (Ang and Piazzesi, 2003; Bikbov and Chernov, 2010; Diebold, Rudebusch, and Aruoba, 2006; Chun, 2011; Ludvigson and Ng, 2009; Wright, 2009), and that macro uncertainty is important (Söderlind, 2009; Wright, 2009) but it does so by focussing on the relation between expected macro conditions and expected term premia whereas earlier papers usually examine the effect of current macro fundamentals. Furthermore, we investigate the relation of our term premium expectations with classic yield curve factors (level, slope, and curvature) as well as the Cochrane and Piazzesi (2005) return forecasting factor. We find that the level and slope of the yield curve seem to capture effects similar to our measures of aggregate uncertainty, which sheds some light on the economic forces underlying these two yield factors. Curvature, in turn, seems to be related to forecasters' term premium expectations themselves, which lines up with findings in Cochrane and Piazzesi (2008).

Finally, we test whether our proxy for term premium expectations is related to future bond excess returns. To this end, we run predictive regressions of bond returns on aggregate term premium expectations in the spirit of Cochrane and Piazzesi (2005) and Ludvigson and Ng (2009). We find that our real-time proxy for term premium expectations forecasts future bond excess returns with predictive R^2s of up to 23% at an annual forecast horizon. This is quite remarkable in our view, given that our term premium proxy is a non-estimated variable (i.e. it is free of potential look-ahead or errors-in-variables problems) and is readily available in real-time. Furthermore, results from our forecasting exercise are in line with the view that our factor proxies for *future changes in risk premia* and not the current level of risk premia as in, e.g., Cochrane and Piazzesi (2005) or Ludvigson and Ng (2009), so that our factor differs from earlier proxies in the bond literature.

The paper proceeds as follows. The next section selectively reviews related literature, Section 3 describes the construction of our proxy for term premium expectations, Section 4 details the data and our panel regression framework, Section 5 presents empirical results, 6 describes several robustness checks and Section 7 concludes. An appendix to this paper contains details on some of our data, variable construction, and our econometric approach and panel regression settings. A separate web appendix contains additional robustness results which are only briefly mentioned in the text.

2 Related Literature

The expectation hypothesis (EH) of interest rates has been serving as a classical point of reference in economics and finance for decades. In its most basic form, it implies that bond risk premia (term premia) are constant over time.[4] However, failures of this concept have been documented for more than 20 years. Early references include Fama and Bliss (1987) and Campbell and Shiller (1991) who show that the difference between forward rates and spot rates or the term spread, respectively, forecast bond (excess) returns. Taking account of this predictability, modern economic models understand risk premia in bond markets to be, in fact, time-varying. Due to the importance of term premia for economics and finance, there is now a vast literature on this topic. Hence, we do not attempt to survey the whole field but rather focus on a few selected studies which investigate the link between macro factors and bond yields. We also pay special attention to the use of survey data for term premium modeling. For a more comprehensive literature overview, see e.g. Diebold, Piazzesi, and Rudebusch (2005) or Kim (2009).

One approach of linking bond risk premia to macro factors is to run predictive regressions of future bond (excess) returns on current macro factors.[5] This is done, e.g., by Ludvigson and Ng (2009) who extract macroeconomic factors from a large data set and find that bond returns are highly predictable with predictive R^2s of up to 26% for U.S. bonds, indicating that term premia are clearly time-varying. They find that a real output factor is an important driver of bond excess returns. A related approach is to run predictive regressions on bond-related variables to compute forecasting factors, and relate these to the business cycle in a second step. For example, Cochrane and Piazzesi (2005) construct a factor based on a linear combination of forward rates for bonds with different maturities to forecast bond excess returns. These authors also show that their factor is related to the business cycle (see also Koijen, Lustig, and Van Nieuwerburgh, 2010, for a related analysis).

The link between yield curve and macro variables is also studied within macro-finance models that

[4] There are different ways of stating the EH as well as its implications (cf. Cochrane, 2005). Here, we refer to the EH as the proposition that there are no time-varying term premia and that holding period excess returns on long-term bonds are not predictable. For a more precise statement see Eq. (1) in Sec. 3.

[5] Throughout the paper, we use the terms “term premium” and “bond risk premium” synonymously.

directly model macro factors together with yield curve models. For example, Ang and Piazzesi (2003) find that output shocks are an important driver of curvature, whereas inflation shocks matter most for the level of the yield curve. They also find that the forecast performance of an affine model with macro factors is better than that of a model with only latent factors. Piazzesi (2005) shows that the slope of the yield curve is driven by shocks to monetary policy.[6] Outside the class of affine no-arbitrage models, Diebold and Li (2006) build on Nelson and Siegel (1987) to develop a method to estimate dynamic yield curve factors precisely for each period from yield data. Several recent papers apply this methodology to study the impact of macro factors on the yield curve and on bond risk premia. Diebold, Rudebusch, and Aruoba (2006) examine the dynamic interaction between macro factors and the yield curve, finding strong evidence for effects of macro on yields but also for effects running from yields to macro variables. Diebold, Li, and Yue (2008) study global yield curve factors which are related to the global business cycle and have resemblance to worldwide inflation and real activity. We contribute to this active literature by directly investigating the relationship between these yield curve factors and the expectations of individual forecasters about future term premia movements.

Our approach of relying on survey information is not at all uncommon in the bond literature. Chun (2011) also uses analyst forecasts on GDP, inflation, and the Federal Funds rate to link fluctuations in bond yields to expectations about monetary policy and macro conditions. Thus, he studies the impact of forward-looking macro expectations on the bond yields, an approach we also follow in this paper.[7] Piazzesi and Schneider (2009) use median forecasts along with predictive regressions to disentangle (aggregate) subjective risk premia and prediction errors of professional forecasters. Wright (2009) uses survey information on long-term inflation, GDP, and interest rates to construct term premium estimates. He also studies the effect of inflation and output uncertainty on risk premia in a panel of countries. Wright ascribes a large amount of the variation in term premia to role of inflation uncertainty. This result seems to make sense, since Piazzesi and Schneider (2006), Campbell, Sunderam, and Viceira (2009), or Rudebusch and Swanson (2008) all argue that inflation uncertainty

[6]There are, of course, other approaches relying on macro-finance linkages based on more standard equilibrium models which also serve to capture the failure of the Expectation Hypothesis and the existence of time-varying risk premia. For example, Wachter (2006) and Buraschi and Jiltsov (2007) study equilibrium models with habit-formation as in Campbell and Cochrane (1999). Bansal and Shaliastovich (2008) and Rudebusch and Swanson (2008) build models with long-run risks based on Bansal and Yaron (2004) to capture failures of the EH and the existence of time-varying bond risk premia. Buraschi and Jiltsov (2005) study risk premia in a money-augmented real business cycle model with taxes and endogenous monetary policy.

[7]However, Chun does not investigate individual forecasters or the impact of inflation and output growth uncertainty.

matters for term premia, a point we pay special attention to in this paper. Söderlind (2009) uses survey information to construct proxies for inflation and output growth uncertainty and finds that uncertainty (as well as liquidity factors) is a significant driver of bond risk premia over the period from 1997 to 2008. Söderlind also finds that output growth uncertainty lowers the term premium whereas inflation uncertainty increases it.

While our study is related to all these papers, we go beyond the existing contributions in the following way: We propose a proxy for term premium expectations which is basically model-free, real-time and easily implementable, and explore a panel of individual forecasters to relate these proxies to macroeconomic *expectations*, measures of aggregate macro uncertainty, and measures of real-time macro activity. To the best of our knowledge, we are the first to analyze these issues in a comprehensive and coherent approach.

3 Measuring Term Premium Expectations

There are a number of ways to derive term premia from surveys which differ with respect to their data requirements and/or their reliance on expected bond returns versus bond yields (see e.g. Piazzesi and Schneider, 2006, 2009; Wright, 2009, for different approaches). We propose a simple way to calculate term premium expectations of individual forecasters that can be readily implemented with minimal data requirements and mild assumptions and approximations. Afterwards, we describe the construction of our term premium expectation proxy and then discuss how to interpret the proxy and how it relates to the related concept of expected bond excess returns.

Construction of our proxy. The expectation hypothesis (EH) implies that long-term yields on zero-coupon bonds are equal to the average of the expected future short-term interest rates and a constant term premium (Campbell and Shiller, 1991),

$$y_t^n = \pi + \frac{1}{k}\sum_{i=0}^{k-1} E_t[y_{t+mi}^m], \tag{1}$$

where y_t denotes a log yield measured in quarter t, n (m) denotes the quarters to maturity of the long-term bond (of a T-bill), $k = n/m$, and π equals the non-varying term premium of holding the long-term bond. Since numerous studies have documented that the EH does not hold due to time-varying term (or risk) premia (e.g. Fama and Bliss, 1987; Campbell and Shiller, 1991), we follow Cochrane and Piazzesi (2008), introducing a time subscript t to π in Equation (1). Considering T-bills with a time to maturity of exactly $m = 1$ quarter as the short rate, we formulate the relationship between long-term and short-term interest rates as

$$y_t^n = \pi_t + \frac{1}{n}\sum_{i=0}^{n-1} E_t[y_{t+i}^1], \tag{2}$$

and in terms of expectations for the interest rate h quarters ahead, we have

$$E_t[y_{t+h}^n] = E_t[\pi_{t+h}] + \frac{1}{n}\sum_{i=0}^{n-1} E_t[E_{t+h}[y_{t+h+i}^1]]. \tag{3}$$

Using the law of iterated expectations and taking differences of Eqs. (3) and (2), we obtain the expected changes in long-term yields

$$E_t[y_{t+h}^n] - y_t^n = E_t[\pi_{t+h}] - \pi_t + \frac{1}{n}\sum_{i=0}^{n-1} E_t[y_{t+h+i}^1] - \frac{1}{n}\sum_{i=0}^{n-1} E_t[y_{t+i}^1]. \tag{4}$$

Rearranging terms yields the expected change in term premia $E_t[\Delta\pi_{t+h}]$, which is given by

$$E_t[\Delta\pi_{t+h}] = E_t[\pi_{t+h}] - \pi_t = E_t[y_{t+h}^n] - y_t^n - \left(\frac{1}{n}\sum_{i=0}^{n-1} E_t[y_{t+h+i}^1] - \frac{1}{n}\sum_{i=0}^{n-1} E_t[y_{t+i}^1]\right). \tag{5}$$

As there are overlapping time periods in the two sum operators (in parentheses on the RHS), some of the expected future short rates cancel out. Choosing $h = 1$ for simplicity, Eq. (5) can be written as

$$E_t[\Delta\pi_{t+1}] = E_t[\pi_{t+1}] - \pi_t = E_t[y_{t+1}^n] - y_t^n - \frac{1}{n}\left(E_t[y_{t+n}^1] - y_t^1\right), \tag{6}$$

which is the expected change in long-term yields minus the difference of the "corner" short-term interest rates (the one which is expected today for the period following the maturity of the long-term bond ($E_t[y_{t+n+1}^1]$) as well as the current one (y_t^1)).

Note that the number of overlapping time periods which cancel out in the two sum operators decreases when a larger forecast horizon h is considered. As a consequence, the expected change in the risk premium includes the difference between the sum of the h "corner" interest rates on each side.

For example, for a horizon of $h = 2$, (5) reads

$$E_t[\Delta\pi_{t+2}] = E_t[y^n_{t+2}] - y^n_t - \frac{1}{n}\left(E_t\left[y^1_{t+n+1} + y^1_{t+n}\right] - E_t[y^1_{t+1}] - y^1_t\right) \tag{7}$$

and similarly for longer horizons. Hence, our measure relates to *expectations about future changes in term premia* and is just the expected yield change of a long-term bond plus a minor adjustment for (expected and current) short rates. However, the latter minor adjustment part does not, in fact, matter for our results presented below as we will show in the robustness section of this paper.

Empirical construction of the proxy. Based on Eqs. (6) and (7), we calculate the expected change in term premia from forecasters' expectations about long-maturity and short-maturity yields. We consider T-bond yields (10 years to maturity) from the SPF to obtain the expectation value in the first component on the RHS in Eqs. (6) and (7), $E_t[y^n_{t+h}] - y^n_t$. Of course, yield expectations in the SPF do not apply to zero-coupon bonds, but we stress that we are examining expectations about *yield changes* and not the level of yields. The yield change of a zero-coupon bond is likely to be much better approximated by the yield change of a coupon bond compared to approximating yield levels of zero-coupon bonds by coupon bonds. In fact, the correlation of zero-coupon bond yield changes in the Gürkaynak, Sack, and Wright (2007) data and changes of T-bond yields (from the FED St. Louis) is approximately 93%. Thus, working with expected yield changes for T-bonds from the SPF does not seem to be an overly strong approximation.[8]

To complete the computation of $E_t[\Delta\pi_{t+h}]$ in Eqs. (6) and (7), we further need to identify the expected short-term interest rates in the second component on the RHS. The expected short rates for subsequent quarters ($E_t[y^1_{t+h}]$) are directly available in the SPF data. However, the dataset does not contain subjective information about the expected short-term interest rates in the distant future $E_t[y^1_{t+n}]$. Therefore, we assume that forecasters expect short-term interest rates in the distant future to equal the unconditional mean of the short-term interest rates for the time period 1981 to the current point in time t, which implies that forecasters rely on past long-run averages when it comes

[8] We provide further robustness on this later in the paper.

to long-run forecasting.[9] We find this a reasonable assumption.[10] Furthermore, we also note that the expression with the short-term interest rate differences is multiplied by $1/n$ (which equals 1/40 in our case, since we are working on a quarterly frequency and consider ten year maturities). Hence, the expected change in bond yields dominates the expression on the RHS of Equations (6) and (7), such that we do not expect the results to be driven by the identifying assumption about long-run forecasts for the short rate as noted above.

In short, we are relying on a combination of expected changes in yields of long and short maturities to obtain an observable proxy for expected changes in term premia. While we have to make some simplifying assumptions, these do not appear to be overly strong and they certainly do not drive our results. Advantages of our proxy are that it can be easily computed in real-time and has no hindsight bias, that it can be constructed for average survey expectations or individual forecaster expectations, and that it is directly observable and does not have to be estimated.

Interpretation of the proxy. Now, what does "expected change in term premia" mean in economic terms? Our term premium expectation factor captures information about *future changes* in term premia, so that our results below cannot be interpreted in the same way as in many other papers where macro factors (or other proxies for business cycle risk) ought to capture the *current levels* of risk premia. For instance, the point in Ludvigson and Ng (2009) is to find business cycle state variables which measure contemporaneous levels of risk premia. Hence, a higher risk premium today signals high required returns and should thus translate into high returns going forward.

How, then, can our proxy be interpreted? In our case, we investigate a proxy for future changes in risk premia which is a different concept: expectations about positive risk premium changes imply that required returns, i.e. discount rates, will rise in the future (without making statements about current levels of risk premia) and should thus translate into lower excess returns in future periods (as future bond prices will fall due to increases in future required risk premia).

[9] For robustness, we also consider the unconditional mean of the short-term interest rates for the time period 1981 to 2009 and do not find important changes.

[10] In our setup, the long-term bond has a maturity of 10 years. Therefore, it is plausible that forecasters have only vague ideas about short-term interest rates 40 quarters ahead, and thus basically forecast the recursive unconditional mean. In this vein, as long as the short-rate is stationary, standard time-series models will also deliver a forecast close to the unconditional mean when iterated 40 periods into the future. In the same vein, standard affine term structure models with no-arbitrage restrictions generally also have an inherent tendency to produce forecasts equal to the recursive unconditional mean (see also the discussion in Cochrane and Piazzesi, 2008).

To underline the relationship between our proxy and expected excess returns, consider the definition of expected excess returns as

$$E_t[rx_{t,t+h}^{n+h}] = E_t[p_{t+h}^{(n)}] - p_t^{n+h} - y_t^h, \tag{8}$$

where $p_t^{(n)}$ denotes the log price in t of a zero bond with a time to maturity of n. As the bond yield is defined as $y_t^n = -p_t^{(n)}/n$, one can solve for $p_t^{(n)} = -ny_t^{(n)}$ and rewrite Eq 8 as

$$E_t[rx_{t,t+h}^{n+h}] = -nE_t[y_{t+h}^{(n)}] + (n+h)y_t^{n+h} - y_t^h \tag{9}$$

To empirically illustrate how tight the relationship between expected excess returns and our proxy for expected in term premium changes actually is, we take $E_t[y_{t+4}^{(n)}]$ from individual survey expectations and compute both the expected excess returns as well as the proxy for the one-year ahead expectations ($h = 4$). (For $y^{(n)}$ and $y^{(n+4)}$ in Eq. (9), we take coupon bond yields of a maturity of 10 and 11 years (40 and 44 quarters), respectively.) The correlation coefficient of $E_t[rx_{t,t+4}^{n+4}]$ and $E_t[\Delta\pi_{t+4}]$ (quarterly mean across sample) is -0.95, which establishes that a *positive value of our proxy* is basically equivalent to a *negative expected excess return*. This, in turn, offers a straightforward economic intuition for our results reported below and we will interpret our results both in terms of expected term premium changes and in terms of expected excess returns, where the latter is just the flip side of the former concept.

However, note that while expected excess returns may be easier in terms of their interpretation, our proxy of expected term premium changes is more suitable for empirical work since it can be computed for quarterly instead of yearly horizons. This point is an important feature of our approach which facilitates the analysis of a relatively short sample.

4 Data and Empirical Approach

4.1 Data Sources and Variable Construction

Data description. Our analysis of the determinants of individual investors' term premium expectations requires expectations about future bond yields and macro variables. We rely on the *Survey of*

Professional Forecasters (SPF) to obtain these micro-level expectations. The SPF covers participants from financial firms, banks, consulting firms, or research centers. The average participation is about 38 forecasters per quarter. We choose the SPF because it contains our variables of interest, because it allows us to calculate sensible measures of forecaster uncertainty (see below), and because its use as a data source is widely established in academic studies (e.g. Ang, Bekaert, and Wei, 2007). Our sample covers 70 quarters from 1992Q1 to 2009Q2 and a total of 153 different forecasters.[11] Of course, timing issues arise when using survey data, and we detail the timing and our approach of aligning survey expectations with other data in the Appendix (see Appendix A.1 and A.2).

We obtain the expected change in the term premium for each forecaster from his or her predictions of 10-year Treasury Bond Yields and 3-months T-bill rates for the subsequent quarters, see Eq. (6) or (7) above. We also include the expectations about real GDP and inflation as explanatory variables in our analysis. For real GDP, we calculate the expected (log) growth rate, i.e. the forecast relative to the nowcast for the current quarter, so that we look at expected output growth. The expected inflation rate is included in levels.

Uncertainty measures. We also derive measures of uncertainty from the density forecasts about real GDP (PRGDP) and inflation (PRPGDP) of the survey. These survey questions ask the forecasters to indicate what probabilities they ascribe to each of ten possible ranges of percentage changes of the GDP levels as well as the price level in the current year and the next year, respectively. The lower and upper category are open-ended. We compute empirical moments of the individual distributions as follows: we consider the outer ranges as closed categories with a midpoint which is equally spaced to the other midpoints in the scale. Based on the midpoints of all categories, we compute the individual means $\theta_{t,i}$ and variances $\sigma^2_{t,i}$ for the probability distributions at each point in time.[12] We adjust the cross-sectional average variance $\sigma^2_t = \frac{1}{N}\sum_{i=1}^{N}\sigma^2_{t,i}$ for seasonality by substracting a season-specific average of σ^2_t from the original values. The adjusted series serve as time-varying measures of aggregate uncertainty about GDP ($\Psi(RGDP_{TY})$,$\Psi(RGDP_{NY})$) and the inflation rate ($\Psi(\text{INF}_{TY})$,$\Psi(\text{INF}_{NY})$) in the current (TY) and the next year (NY), respectively.

[11] The SPF did not include questions about Treasury yield expectations before 1992.

[12] Our choice of inferring uncertainty from density forecasts and not from cross-sectional point forecast dispersion (as e.g. in Wright, 2009) is based on findings in the literature which suggest that forecast dispersion may be a somewhat crude proxy for uncertainty (although the two measures are correlated, of course). For the sake of brevity, we refer to Giordani and Söderlind (2003), Lahiri and Sheng (2010), Liu and Lahiri (2006), and Pesaran and Weale (2006) for details on these issues.

Figure 1, Panel (a), shows a time-series plot of our proxies for inflation and GDP uncertainty. Note that our procedure of measuring uncertainty yields somewhat different results than earlier papers. For example, Wright (2009) finds that uncertainty (measured as forecast dispersion) increases heavily during the financial crisis in 2007 to 2009. We also find increased uncertainty before the outbreak and at the beginning of the crisis, but uncertainty quickly decreases as forecasters become quite certain that GDP growth and inflation rates will fall. Thus, part of the large forecast dispersion in Wright (2009) seems to stem from forecasters' disagreement, but not necessarily from their uncertainty.

Panel (b) of Figure 1 shows a scatter plot of inflation and output growth uncertainty. As may be expected, the two series are positively correlated (e.g., $Corr(\Psi(\text{RGDP}_{NY}), \Psi(\text{INF}_{NY})) = 0.5$). Thus, we compute an orthogonalized measure of inflation uncertainty, namely the residuals of the regression of $\Psi(\text{INF}_{NY})$ on $\Psi(\text{RGDP}_{NY})$ and a constant. The resulting time series (denoted $\Psi(\text{INF}_{NY})^{\perp}$) has a high correlation of 0.86 with the unadjusted inflation uncertainty measure $\Psi(\text{INF}_{NY})$ but is uncorrelated with real GDP uncertainty by construction.

Figure 1 about here

Real Time Data. For our empirical analysis, we also make use of real time yield data (mainly based on the data by Gürkaynak, Sack, and Wright (2007)), which are also used to construct yield curve factors as in Diebold and Li (2006) and the bond factor of Cochrane and Piazzesi (2005), denoted CP. Furthermore, we rely on real-time data on real GDP growth, CPI inflation, industrial production (IP) and money growth (in M2), as well as CRSP bond returns for several maturities. To save space, however, we detail the data sources, variable constructions and timing issues in the appendix to this paper (see Appendix A.1 and A.2).

4.2 Empirical Approach

We are interested in the determinants of expected term premium changes of individual investors. These determinants include other forward-looking variables (individual macro expectations) which have to be treated as being endogenous, as well as variables that can be considered exogenous. We thus specify our general (dynamic) panel regression model as

$$e_{i,t} = a_1 e_{i,t-1} + \Xi_{i,t}\gamma + \Psi_t\delta + Z_t\beta + \epsilon_{i,t} \tag{10}$$

where $e_{i,t}$ is a shortcut for the expected change in term premia, i.e. $e_{i,t} \equiv E_{i,t}[\Delta\pi_{t+h}]$. $\Xi_{i,t} \equiv E_{i,t}[X_{i,t+h}]$ denotes a vector of subjective expectations of forecaster i about macroeconomic variables such as expected output growth and expected inflation, vector Ψ_t collects measures of aggregate uncertainty about future output growth and inflation rates, and Z_t denotes a vector of additional exogenous control variables. Our interest centers on the effect of expected macro movements $\Xi_{i,t}$ and uncertainty about macro movements Ψ_t on individual expectations about future bond risk premia $e_{i,t}$. Lagged (expected) risk premium changes and other observed macro factors in Z merely serve as control variables or are included to highlight additional aspects regarding the relation of our term premium expectations with other well-known factors. The specification of the error term $\epsilon_{i,t} = \alpha_i + \mu_{i,t}$ takes into account that forecasters' expectations may exhibit unobserved heterogeneity. Hence, we work with a fixed effects setting and investigate time variation in term premia.

In Eq. (10), we regress current expectations about future risk premium changes $e_{i,t}$ on expectations about other macroeconomic variables $E_{i,t}[X_{i,t+h}]$ to single out the effect of expected macro movements on bond risk premia. While this approach is natural for our analysis, it generates a potential endogeneity problem since there is no reason to assume that causality strictly runs from $E_{i,t}[X_{i,t+h}]$ to $e_{i,t}$ and not vice versa. To tackle this challenge we rely on instrumental variable estimators for all our main results and instrument for current macro expectations with lagged macro expectations. We do this within the Generalized Method of Moments (GMM) framework of Arellano and Bond (1991). Furthermore, we take care of potential problems arising from the inclusion of too many instruments in panel regressions with a large time dimension relative to the cross-sectional dimension of the panel, and we account for autocorrelation and heteroskedasticity in our inference. As our dataset is an unbalanced panel, we rely on jackknifed standard errors, which are based on repeated estimations while omitting randomly one observation in each iteration step. Details on the exact estimation of the dynamic panel data model, the choice of instruments, and computation of standard errors are delegated to the appendix of this paper (see Appendix A.3). We have also checked that our results are not driven by the specific estimation method of Arellano and Bond (1991) and obtained findings very similar to those reported below in other estimation setups (e.g. 2SLS) or in a pooled regression framework.

5 Results

5.1 Properties of Term Premium Expectations

To set the stage, we plot time-series of aggregated expected term premium changes for horizons of one to four quarters in Figure 2 (red, solid line). We also show the "*realized term premium changes*" (blue, dashed line), which are computed by simply replacing expected log yield in Eq. (6) with actual future log yields. As one may expect, it can be seen that *expected* term premia are quite persistent and seem to be less volatile than *realized* changes in term premia. Compared to ex-post realizations of bond returns (or yield changes), the real time expectations about term premium changes appear to be a less noisy measure and should thus serve as a useful proxy to study the link between macro factors and term premia.

As a final note, there is a large decline in term premium expectations towards the end of our sample, starting with the onset of the financial crisis in 2007. This result is well in line with a 'flight-to-quality' effect and is also found in Wright (2009), lending some credence to the relevance of our proxy for term premium expectations.

FIGURE 2 ABOUT HERE

Table 1 shows descriptive statistics for *expected* term premium changes on the left side and for *realized* term premium changes on the right side for comparison. Both are negative on average. This confirms earlier analyses showing a decline of term premia in advanced countries over the time period of our sample (Wright, 2009). Furthermore, the standard deviations shown in Table 1 validate the perception that *expected* term premium changes are less volatile than *actual* changes. This effect becomes more pronounced for longer forecast horizons h.

TABLE 1 ABOUT HERE

5.2 Macro Expectations and Aggregate Uncertainty

As noted above, our main interest lies in the impact of macro expectations and uncertainty of individual term premium expectations as specified in Eq. (10). Thus, we now proceed to estimate dynamic panel regressions with fixed effects via GMM. We regress forecaster-specific term premium expectations on lagged term premium expectations, forecaster-specific expectations about output growth and inflation, as well as aggregate uncertainty about output growth and inflation and report our results in Table 2 for various combinations of explanatory variables.

We robustly find that individual term premium expectations, or expected bond excess returns, are positively autocorrelated: the lagged dependent variable has a coefficient of about 0.25-0.40 across specifications, which is highly significantly different from zero. This persistence makes sense since it is well known that expected excess returns on financial assets are persistent. We control for this persistence in all future regressions by including the lagged expected term premium change as a regressor.

Perhaps more interestingly, we find that expected real output growth ($E_{t,i}[\Delta \text{RGDP}]$) has a significantly positive impact as well, so that higher growth expectations induce forecasters to expect the term premium to rise or, equivalently, expected future excess returns to be low. This finding seems natural from a standard asset pricing perspective since good states of nature should lead to lower risk premia. Furthermore, this result supports findings in Ludvigson and Ng (2009) that real macro activity is a strong time-series predictor of bond excess returns. The strong evidence in our study reinforces the view that real factors are an important driver of bond risk premia. It should be noted, however, that Ludvigson and Ng (2009) find that return forecasts are high when *current* real activity is low and interpret this as a countercyclical bond risk premium. Our findings suggest that low *expected* output growth makes forecasters expect lower term premium changes going forward. As explained earlier, this is well in line with our findings: as declining risk premia in the future imply higher returns going forward, the two results are actually compatible in terms of their economic effects. The difference is thus one of interpretation and not of economic outcomes.[13]

We also find a positive coefficient for expected inflation ($E_{t,i}[\text{INF}]$). However, the impact of expected

[13] Also, this difference is not driven by using expectations (our study) instead of current output growth (as in Ludvigson and Ng (2009)). We show below that current output growth is positively related to expectations about changes in future term premia as well.

inflation on term premium changes is not significant in all specifications and becomes unimportant once we include uncertainty measures or include it jointly with real GDP expectations. At first sight, this result seems surprising since inflation is considered to be a prime candidate for driving term premia. Earlier papers usually see a stronger role of inflation in determining bond yields (see e.g. Ang and Piazzesi, 2003; Diebold, Rudebusch, and Aruoba, 2006; Rudebusch and Wu, 2008). However, we are investigating expected *changes* in term premia whereas most earlier papers show that inflation relates to the *level* of bond yields and risk premia. Furthermore, one has to bear in mind that our sample period (starting in 1992) is not one of particularly high inflation rates. In this specific macroeconomic setting, it may well be that inflation levels are relatively less important than real growth or uncertainty.[14]

Table 2 about here

Turning to our uncertainty measures, we find that uncertainty unambiguously leads forecasters to raise their expectations about future term premia, i.e. higher aggregate uncertainty in the current quarter leads forecasters to expect lower excess returns in the future. This finding seems to make sense from a 'flight-to-safety' perspective where higher macro uncertainty leads to a rush on safe assets such as U.S. government bonds which drives up their prices in the current period while lowering expected future returns on these assets.[15]

Interestingly, we find that both output growth uncertainty and inflation uncertainty are significant drivers of term premium expectations even when we include both uncertainty sources simultaneously (specification (ix)) by using the orthogonalized inflation uncertainty series. Strikingly, this finding indicates that both "*real uncertainty*" and "*nominal uncertainty*" (about real and nominal macro factors), by themselves, matter.[16]

Regarding the economic significance of our explanatory variables, we find (based on the joint

[14] This result is, again, in line with Ludvigson and Ng (2009) who find that inflation is far less important than real activity.

[15] Note that Anderson, Ghysels, and Juergens (2009) document a positive relationship between uncertainty and *stock* excess returns. However, due to flight-to-safety behavior, bond markets and stock markets tend to behave differently in times of high uncertainty (see, e.g., Connolly, Stivers, and Sun, 2005): investors tend to *sell* stocks in favor of bonds when uncertainty is high, which drives down stock prices in the current period while increasing expected future returns.

[16] Wright (2009) also finds that inflation uncertainty matters, but does not ascribe a large role to output uncertainty. Similarly, Söderlind (2009) finds that inflation uncertainty has a positive impact on term premia, but also that higher output uncertainty lowers risk premia. Our results – which are based on a different concept of measuring uncertainty as well as a different sample period – suggest otherwise.

specification (ix) in Table (2)) that the long-run impact after taking into account the autoregressive effects is about 20 basis points for a one-standard deviation shock to expected real GDP growth and about 3 basis points for the two uncertainty measures. While these effects may appear small at first sight, one has to put this into the perspective of an unconditional standard deviation of "only" 40 basis points of the dependent variable, i.e. expected term premium changes. Thus, a rise of one standard deviation in expected real output growth has an effect that makes up for about 50% of the standard deviation of expected term premium changes and the other two determinants still have an impact of about 7%-12% relative to a typical movement in the dependent variable. Thus, expected real output growth has a rather large impact on expected term premium changes, whereas uncertainty is still economically significant but clearly less important.[17]

We also report Pseudo R^2s and a couple of diagnostic statistics. We see that R^2s are around 35% in specifications including uncertainty and/or output growth expectations and are somewhat lower if only inflation expectations are included. The J-test is far from rejecting the overidentifying restrictions and residuals seem largely free from autocorrelation (we test for second-order autocorrelation since we have a fixed-effects setting), except for the last three specifications which are significant at the 10%-level only.

5.3 Yield Curve Factors and CP-Factor

Given the prominence of yield curve factors in the literature, we next look at the relation of level, slope, and curvature (obtained as in Diebold and Li, 2006) with our proxy for term premium expectations.[18] We also include the *CP Factor*, which has been proposed by Cochrane and Piazzesi (2005) to forecast excess returns of bonds of different maturities. Given that subjective term premium expectations have predictive power, they are also related to future bond returns. Hence, the CP-Factor should be able to explain expected changes in the term premium to some extent.

A plot of the four factors is shown in Figure 3. The plot shows the decline of the level of yields during the 1990s and 2000s (Panel (a)), the inverted yield curves prior to the last two recessions

[17] As a robustness check, we provide results for specifications with a recession dummy (Table A.I) and for regressions where we use expectations for annual horizons, i.e. $h = 4$, in Table A.II in the Appendix to this paper. It can be seen from these robustness tests that our results are not driven by events of the recent financial crisis.

[18] Note that the Diebold and Li procedure results in a "slope" factor that has an almost perfectly negative correlation with the term spread. Thus, we multiply our slope factor with -1 so that a high slope means a steep yield curve.

(Panel (b)), and the curvature factor in Panel (c), which is similar to the average subjective term premium expectations in Figure 2. In fact, curvature and term premium expectations have a positive correlation of about 67%. This result seems especially noteworthy in the light of findings in Cochrane and Piazzesi (2008), who report that curvature is linked to *future* expected returns (as opposed to current term premia). This is exactly what our expected term premium proxy ought to capture as well. Finally, the CP-Factor in Panel (d) seems to be rather unrelated to the three other yield factors, as already motivated in Cochrane and Piazzesi (2005).

Figure 3 about here

Next, we include the four bond yield factors in our dynamic panel regression. It is well-known that level, slope, and curvature span most macro information relevant for bond yields, so it seems interesting to see whether they drive out our proxy of expected term premium changes as well. Also, since information in the term structure is related to the business cycle (see Estrella and Hardouvelis, 1991; Ang, Piazzesi, and Wei, 2005, among many others) and since the CP factor is informative about future macro conditions (Koijen, Lustig, and Van Nieuwerburgh, 2010), we present results from joint specifications where we include macro expectations, uncertainty, and bond factors in Table 3. These results aim for a closer investigation of possible relationships between yield-related and macro factors and are reported in Table 3.

Table 3 shows that level, slope, curvature, and the CP factor are significantly different from zero in all specifications. The estimated signs of factors seem to make sense when comparing them with earlier literature. For example, Diebold, Rudebusch, and Aruoba (2006) find that the *level* factor captures *inflation* (also see Rudebusch and Wu, 2008). To the extent that forecasters have mean-reverting expectations anchored at some level of inflation, one would expect a high level factor (i.e. high inflation) to be accompanied by high contemporaneous term premia but lower term premia expectations for the future (which imply high expected excess returns).[19] A similar argument may be made for the *slope*, for which Diebold, Rudebusch, and Aruoba (2006) argue that it may be interpreted as a proxy for *real activity*. While Diebold, Rudebusch, and Aruoba (2006) find that *curvature* seems rather unrelated to macro factors, our results and the discussion above suggest that curvature is highly correlated with expectations about future bond risk premia. We also see this positive relation in the

[19]We provide additional evidence on this later in the paper.

panel regressions.

Finally, the CP factor is negatively related to expectations about future term premia, i.e. positively related to expected excess returns as in Cochrane and Piazzesi (2005) which further validates our term premium proxy. Cochrane and Piazzesi (2005), Ludvigson and Ng (2009) and others find strong evidence that *return* risk premia are countercyclical. In this paper, we show that this *counter*cyclical nature of return risk premia corresponds to a *pro*cyclical behavior of term premia expectations: as shown above, high GDP growth expectations today are associated with term premia expected to increase in the future. In the same vein, it also is reassuring to see the CP regression-based results reflected in the actual expectations of individual investors.

Interestingly, we find that level and slope both drive out aggregate uncertainty (whereas curvature and CP do not), suggesting that these two factors also capture uncertainty about real and nominal variables. This result seems novel to the literature and may shed some more light on the economic forces underlying these popular yield curve factors. It is also worth noting that expected real GDP growth is not driven out by any combination of other factors and even remains significant in the full specification (v). This underlines the role of expected output growth in the expectation formation with respect to movements in term premia.

TABLE 3 ABOUT HERE

5.4 Real-time Macro Factors and Expected Term Premium Changes

As a final test, we also include real-time macro factors in our regressions to find out whether focusing on *expected* macro conditions yields additional insights relative to relying on *current* macro conditions. We rely on real-time vintage data and include growth rates of industrial production, GDP growth, CPI inflation, and real money growth (M2). Results for various specifications are collected in Table 4.

Our estimates show that current real-time CPI inflation has a significantly *negative* impact on term premium expectations at the micro-level, i.e. higher inflation raises expected excess returns on government bonds. This is in contrast to our findings above where *expected* inflation has a positive impact on expected term premium changes. This result is rather counterintuitive but may be understood by forecasters' reliance on mean-reversion and anchored inflation expectations. To the extent that relatively high inflation leads forecasters to expect lower inflation in the future, this negative coefficient is in line with our finding that high expected inflation increases term premium expectations as shown above. This finding, however, underlines the importance of investigating forward-looking drivers of term premia rather than determinants mirroring the current state of the economy, as these two approaches may yield very different results.

Having said this, we find that output growth (growth of industrial production and GDP) has a significantly positive impact on expected term premia, just as our measure of expected output growth does. Thus, relying on expected as well as actual macro conditions leads to similar results. However, our estimates also reveal that actual, real-time output growth does not drive out expected output growth and the latter is still highly significant in all specifications examined in Table 4. Once again, these results emphasize that there is a role for forward-looking macro factors when modelling term premia over and above the information contained in the current state of the economy.

Table 4 about here

5.5 Predictive Regressions

Our results in the previous sections deal with individual expectations about future term premium movements and the impact of macro expectations and uncertainty on these risk premium expectations. While we believe that this approach provides valuable insights into how macro factors affect term premia, it is also of interest to see whether our term premium expectations are actually related to future bond returns or whether forecasters' expectations are merely an unimportant side-show for bond markets. A link between future bond excess returns and expectations of forecasters with respect to term premium movements would clearly strengthen the case for our findings. To shed some light on this issue, we run predictive regressions as in Cochrane and Piazzesi (2005) or Ludvigson and Ng (2009)

$$rx(m)_{t+h} = \alpha_h + \beta_h \overline{e}_t + \varepsilon_{t+h} \tag{11}$$

of future bond excess returns $rx(m)$ on current average term premium expectations $\overline{e}_t$, i.e. we use the average forecast across individuals discussed in Table 1 and Figure 1 above. The forecast horizon h varies from one to four quarters and we match the forecast horizon of returns with the forecast horizon of subjective term premium expectations. m denotes the maturity of the bonds underlying the excess returns and we also include average excess returns across all maturities (denoted $rx(avg)$). We report t-statistics based on Newey and West (1987) standard errors (with h lags for robustness) and also based on Hodrick (1992) standard errors which were shown to have better size properties when forecasting with persistent regressors (see Ang and Bekaert, 2007).[20]

If term premium expectations matter for bond markets, we would expect to see a significant impact of expectations on future bond returns, i.e. that the coefficient β_h is significant in Eq. (11). More specifically, we would expect to find a negative coefficient since higher term premia in the future imply that future bond yields must rise (relative to the short-rate) so that actual bond excess returns have to be lower.

Results from these predictive regressions for maturities of $m = 1, 2, \ldots, 5, 10$ years and the average excess return over all maturities $rx(avg)$ are provided in Table 5. Note that we only include data until 2007Q2 since there are enormous return movements due to the subsequent financial crisis and these outliers drive much of our result given that we have a relatively short time-series.[21] We thus limit our analysis to "normal" situations and exclude extreme events.

Given this caveat, our results show that term premium expectations forecast bond excess returns with rather low R^2s of up to 4% at a quarterly forecast horizon, but with R^2s of up to 22% at an annual forecast horizon. The R^2s as well as the levels of statistical significance (even when based on Hodrick (1992) standard errors) tend to increase with longer forecast horizons of up to four quarters. Predictive R^2s are largest for excess returns over maturities between one to three years but we also find significant predictability at longer maturities. At an annual forecast horizon, expected term premium changes forecast average bond excess returns across maturities with an R^2 of around 13% and predictability is stronger for short horizons with R^2s as high as 22% for one-year maturities. While other papers (Cochrane and Piazzesi, 2005) find much higher R^2s (of up to 45%) for annual horizons (Cochrane and Piazzesi, 2005; Ludvigson and Ng, 2009) in longer samples, it should be noted that our factor is available in real-time and not estimated as in other papers. We will provide more details on this issue

[20] Average term premium expectations have an autocorrelation of "only" 70%, see Table 1, which is not very high relative to other predictors such as dividend yields in stock markets. Thus, we expect finite-sample biases (Stambaugh, 1999) to be fairly mild in our sample.

[21] More precisely, our sample is short relative to sample sizes usually employed for predictive regressions. This fact is important, since actual returns are noisy and it is thus difficult to estimate expected returns from actual returns with sufficient precision. Thus, we choose not to include the extremely unusual market movements of the financial crisis in our regressions since these data points would swamp our results.

below.

Table 5 about here

Furthermore, we find a consistently negative predictive coefficient across forecast horizons and maturities as expected. Hence, our results suggest that forecasters' expectations contain relevant information for future bond returns and that movements in expected discount rates matter for bond excess returns, especially at the shorter end of the maturity spectrum.

The question remains whether our proxy for term premium expectations captures the same information as other bond predictors known from the literature. As a comparison, we re-estimate our predictive regressions with a real-time (i.e. recursively estimated) CP-factor instead of our term premium expectations $E_t[\Delta\pi_{t+1}]$. Results are reported in the Web Appendix to conserve space (see Table A.V). We find that the CP factor works best for longer maturities and short forecast horizons (where it clearly dominates our factor) during our sample period whereas our factor performs best for longer forecast horizons and shorter maturities (where it outperforms the CP factor). Hence, our proxy for term premium expectations seems to capture pieces of information which complement the insights that can be gained by the usage of the CP factor.[22] The results we have discussed in the previous sections are therefore not only relevant to describe patterns of the (potentially irrational and subjective) expectation formation of professional forecasters, but may improve our understanding of risk premia movements in bond markets more generally.

6 Robustness

We briefly summarize results for some robustness checks relating to the main results of our paper. We only describe these results here and provide detailed tables with all results in the Appendix to this paper.

First of all, we have re-estimated our main result and include a dummy for NBER recessions to see whether such a dummy contains information not captured by our benchmark macro factors. Table

[22]We also find that our factor is different when we compare it to real-time measures of growth in industrial production. Ludvigson and Ng (2009) show that their real macro factor is related to industrial production growth so that this comparison again suggests that expected term premium expectations are different.

A.I in the Appendix reports results for this specification. We find (in specification (i)) that times of recession indicate significantly lower expected term premium changes, i.e. higher expected excess returns, which makes intuitive sense. However, we also find that the impact of the recession dummy turns insignificant once we include our benchmark macro expectations and uncertainty factors. Hence, our results seem robust to this.

Second, we report our main result for a forecast horizon of four quarters. As noted in Section 3 above, our proxy of expected term premium changes can be constructed for horizons of one to four quarters based on SPF data. However, for the sake of brevity, we focus on a forecast horizon of one quarter in most of our results above. We show in Table A.II, though, that our results are robust to using a longer forecast horizon of 4 quarters. We also obtain similarly robust results for horizons of two or three quarters.

Third, we provide results based on a simplified proxy for expected term premium changes which does not rely on a long-run forecast of short-term interest rates. More specifically, we drop the last term in Eq. (6) when computing our proxy. Hence, our proxy is computed as

$$E_t[\Delta\pi_{t+1}] = E_t[\pi_{t+1}] - \pi_t = E_t[y^n_{t+1}] - y^n_t \tag{12}$$

and we are effectively leaving out the long-run forecast of future short-term interest rates which may be hard to compute with high precision anyway. We report results for this simplified proxy in Table A.III in the Appendix and find that our results in the main text are robust to this modification.

Finally, we check for robustness of another component of our proxy for expected term premium changes. In order to compute expected term premium changes, Eq. (6), which we repeat here for convenience,

$$E_t[\Delta\pi_{t+1}] = E_t[y^n_{t+1}] - y^n_t - \frac{1}{n}\left(E_t[y^1_{t+n}] - y^1_t\right),$$

tells us to compute the difference between expected bond yield and current zero-coupon bond yields $E_t[y^n_{t+1}] - y^n_t$. As discussed in Section 3 above, we have approximated these yields with expected and actual yields of coupon bonds with a maturity of ten years. However, since 10-year coupon bonds have a duration of approximately 7 seven years over our sample period, we re-estimate our main results with a proxy based on coupon bond yields with a duration of seven years. Results are shown in Table A.IV in the Appendix and corroborate our findings in the main text.

7 Conclusions

We analyze *individual* expectations about term premium movements in a panel of forecasters and relate these individual expectations to expected real and nominal macro variables, to aggregate uncertainty about real and nominal macro variables, as well as to further control variables, such as term structure factors, risk-related factors, and real-time macro developments. A novel aspect of our analysis is our focus on the impact of inherently forward-looking macro factors on expectations about term-premia in a panel approach which allows for heterogeneity across forecasters. We find that individual forecasters' macro expectations are strongly related to expectations about bond risk premia, and we find the largest impact for real output growth and uncertainty about real output growth. Thus, there is a strong link between macro developments and term premia in bond markets.

Furthermore, our results suggest that curvature of the term structure is strongly related to subjective expectations about term premia, while the level and slope factors seem to capture information similar to that contained in our uncertainty measures about future real output growth and inflation. We also show that focusing on expected *future* macro conditions can lead to different results than analyzing the impact of *current* macro conditions on risk premia, and that expected macro conditions contain information for term premia over and above the information contained in current (real-time) macro conditions. Finally, an aggregate measure of term premium expectations forecasts future bond returns over horizons of up to one year in a way that is consistent with the idea that our proxy for expected term premium changes forecasts future changes in discount rates.

References

Anatolyev, S., and N. Gospodinov (2010): "Specification Testing in Models with Many Instruments," *Econometric Theory*, forthcoming.

Anderson, E. W., E. Ghysels, and J. L. Juergens (2009): "The Impact of Risk and Unvertainty on Expected Returns," *Journal of Financial Economics*, 94, 233–263.

Ang, A., and G. Bekaert (2007): "Stock Return Predictability: Is it there?," *Review of Financial Studies*, 20(3), 651–707.

Ang, A., G. Bekaert, and M. Wei (2007): "Do Macro Variables, Asset Markets, Or Surveys Forecast Inflation Better?," *Journal of Monetary Economics*, 54, 1163–1212.

Ang, A., and M. Piazzesi (2003): "A No-Arbitrage Vector Autoregression of Term Structure Dynamics with Macroeconomic and Latent Variables," *Journal of Monetary Economics*, 50(4), 745–787.

Ang, A., M. Piazzesi, and M. Wei (2005): "What does the yield curve tell us about GDP growth," *Journal of Econometrics*, 131, 359–403.

Arellano, M., and S. Bond (1991): "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *The Review of Economic Studies*, 58(2), 277–297.

Bansal, R., and I. Shaliastovich (2008): "A Long-Run Risks Explanation of Predictability Puzzles in Bond and Currency Markets," *Working Paper*.

Bansal, R., and A. Yaron (2004): "Risks For the Long Run: A Potential Resolution of Asset Pricing Puzzles," *Journal of Finance*, 59, 1481–1509.

Bikbov, R., and M. Chernov (2010): "No-Arbitrage Macroeconomic Determinants of the Yield Curve," *Jounal of Econometrics*, 159, 166–182.

Blundell, R., and S. Bond (1998): "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models," *Journal of Econometrics*, 87(1), 115–143.

Buraschi, A., and A. Jiltsov (2005): "Inflation Risk Premia and the Expectation Hypothesis," *Journal of Financial Economics*, 75, 429–490.

——— (2007): "Habit Formation and Macroeconomic Models of the Term Structure of Interest Rates," *Journal of Finance*, 62, 3009–3063.

Cameron, A. C., and P. K. Trivedi (2005): *Microeconometrics: Method and Applications*. Cambridge: Cambridge University Press.

Campbell, J. Y., and J. H. Cochrane (1999): "By Force of Habit: A Consumption Based Explanation of Aggregate Stock Market Behavior," *Journal of Political Economy*, 107(2), 205–251.

Campbell, J. Y., and R. J. Shiller (1991): "Yield Spreads and Interest Rate Movements: A Bird's Eye View," *Review of Economic Studies*, 58, 495–514.

Campbell, J. Y., A. Sunderam, and L. M. Viceira (2009): "Inflation Bets or Deflation Hedges? The Changing Risks of Nominal Bonds," *Working Paper, Harvard University*.

Chun, A. L. (2011): "Expectations, Bond Yields and Monetary Policy," *Review of Financial Studies*, 24(1), 208–247.

Cochrane, J. H. (2005): *Asset Pricing (Revised Edition)*. NJ: Princeton University Press.

Cochrane, J. H., and M. Piazzesi (2005): "Bond Risk Premia," *American Economic Review*, 95(1), 138–160.

——— (2008): "Decomposing the Yield Curve," Working Paper, Chicago Booth.

Connolly, R., C. Stivers, and L. Sun (2005): "Stock Market Uncertainty and the Stock-Bond Return Relation," *Journal of Financial and Quantitative Analysis*, 40, 161Ű94.

Diebold, F. X., and C. Li (2006): "Forecasting the Term Structure of Government Bond Yields," *Journal of Econometrics*, 130(2), 337–364.

Diebold, F. X., C. Li, and V. Z. Yue (2008): "Global Yield Curve Dynamics and Interactions: A Dynamic Nelson-Siegel Approach," *Journal of Econometrics*, 146, 351–363.

Diebold, F. X., M. Piazzesi, and G. D. Rudebusch (2005): "Modeling Bond Yields in Finance and Macroeconomics," *American Economic Review, Papers & Proceedings*, 95, 415–420.

Diebold, F. X., G. D. Rudebusch, and S. B. Aruoba (2006): "The Macroeconomy and the Yield Curve: A Dynamic Latent Factor Approach," *Journal of Econometrics*, 131(1-2), 309–338.

Estrella, A., and G. Hardouvelis (1991): "The term spread as a predictor of real economic activity," *Journal of Finance*, 46, 555–576.

Fama, E. F., and R. R. Bliss (1987): "The Information in Long-Maturity Forward Rates," *American Economic Review*, 77, 680–692.

Giordani, P., and P. Söderlind (2003): "Inflation Forecast Uncertainty," *European Economic Review*, 47, 1037–1059.

Gürkaynak, R., B. Sack, and J. Wright (2007): "The US Treasury Yield Curve: 1961 to the Present," *Journal of Monetary Economics*, 54(8), 2291–2304.

Hansen, L. P. (1982): "Large Sample Properties of Generalized Method of Moments Estimators," *Econometrica*, 50(4), 1029–1054.

Hodrick, R. J. (1992): "Dividend Yields and Expected Stock Returns: Alternative Procedures for Inference and Measurement," *Review of Financial Studies*, 5(3), 357–386.

Kim, D. H. (2009): "Challenges in Macro-Finance Modeling," *Federal Reserve Bank of St. Louis Review*, 91, 519–544.

Koijen, R. S. J., H. Lustig, and S. Van Nieuwerburgh (2010): "The Cross-Section and Time-Series of Stock and Bond Returns," *AFA 2010 Meetings paper*.

Lahiri, K., and X. Sheng (2010): "Learning and Heterogeneity in GDP and Inflation Forecasts," *International Journal of Forecasting*, 26, 265–292.

Liu, F., and K. Lahiri (2006): "Modelling Multi-period Inflation Uncertainty Using A Panel Of Density Forecasts," *Journal of Applied Econometrics*, 21, 1199–1219.

Ludvigson, S. C., and S. Ng (2009): "Macro Factors in Bond Risk Premia," *Review of Financial Studies*, 22(12), 5027–5067.

Nelson, C. R., and A. F. Siegel (1987): "Parsimonious Modeling of Yield Curves," *Journal of Business*, 60(4), 473–489.

Newey, W. K., and K. D. West (1987): "A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix," *Econometrica*, 55(3), 703–708.

Pesaran, M. H., and M. Weale (2006): “Survey Expectations,” in *Handbook of Economic Forecasting*, ed. by G. Elliott, C. W. Granger, and A. Timmermann. North-Holland, vol. 1, chap. 14, pp. 715–776.

Piazzesi, M. (2005): “Bond Yields and the Federal Reserve,” *Journal of Political Economy Volume*, 113, 311–344.

Piazzesi, M., and M. Schneider (2006): “Equilibrium Yield Curves,” *NBER Macro Annual*, 21, 389–442.

——— (2009): “Trend and Cycle in Bond Risk Premia,” *Working Paper, Stanford University.*

Roodman, D. (2009): “A note on the theme of too many instruments,” *Oxford Bulletin of Economics and Statistics*, 71, 135–158.

Rudebusch, G. D. (2010): “Macro-Finance Models of Interest Rates and the Economy,” *Working Paper, Fed San Francisco.*

Rudebusch, G. D., and E. T. Swanson (2008): “Examining the Bond Premium Puzzle with a DSGE Model,” *Journal of Monetary Economics*, 55, S111–S126.

Rudebusch, G. D., and T. Wu (2008): “A Macro-Finance Model of the Term Structure, Monetary Policy, and the Economy,” *Economic Journal*, 118, 906–926.

Söderlind, P. (2009): “Inflation Risk Premia And Survey Evidence On Macroeconomic Uncertainty,” *Working Paper, St. Gallen.*

Stambaugh, R. F. (1999): “Predictive Regressions,” *Journal of Financial Economics*, 54, 375–421.

Wachter, J. A. (2006): “A Consumption-based Model of the Term Structure of Interest Rates,” *Journal of Financial Economics*, 79, 365–399.

Windmeijer, F. (2005): “A Finite Sample Correction for the Variance of Linear Efficient Two-Step GMM Estimators,” *Journal of Econometrics*, 126(1), 25–51.

Wright, J. H. (2009): “Term Premia and Inflation Uncertainty: Empirical Evidence from an International Panel Dataset,” *Amercian Economic Review*, forthcoming.

Appendix

A.1 Data

Timing of survey expectations. The SPF questionnaires are sent to the participants at the end of the first month of each quarter. As the deadline for returning the questionnaires is the middle of the second month of the respective quarter, the professional forecasters respond within a two-week time-frame. Based on this response procedure, we refer to the period from the last survey deadline to the current one as a *survey quarter*. Note that unlike the *target quarter*, which corresponds to the conventional calendar quarters, *survey quarters* are spaced from Nov/16-Feb/15, Feb/16-May/15, May/16-Aug/15 and Aug/16 to Nov/15 in each year.

Interest rates and yields. We collect three months US T-bill rates and US Corporate Bond Yields (by the Federal Reserve) from *Datastream*. Bond yields for longer maturities are taken from the smoothed US Treasury yield curve data provided by Gürkaynak, Sack, and Wright (2007). These daily time series can be transformed into several variables required by our analysis: We consider the *last* realization in January, April, July and October of T-bill rates and ten-year-to-maturity bond yields in the respective information sets (including for the computation of risk premia as indicated in Equations (6) and (7). In contrast, we take the *mean* of the daily short rates and 10 years bond yields to construct series of *realized* changes in term premia. We also compute the log change of interest rates between the first and the last day in a survey quarter ($\Delta TBOND$, $\Delta TBILL$) as well as the standard deviation of daily interest rates within a survey quarter ($\sigma(TBOND)$, $\sigma(TBILL)$), respectively.

Macroeconomic Variables. To operate with macroeconomic figures which have actually been available to the forecasters, we exploit the real time data collected by the *Federal Reserve Bank of Philadelphia*. In particular, we consider the US total industrial production index (IP), the consumer price index (CPI), the real gross domestic product (RGDP) as well as the nominal money stock (M2). The real time data set ignores future data revisions or redefinitions and facilitates a relatively accurate timing of the information inflow. As the SPF does not include the exact individual response date, we assume that economic figures are included in the forecasters' information set if they are released by the end of the first month in a quarter (January, April, July, October). We transform all variables to (log) year-over-year growth rates (except for inflation). As the CPI has only been available in the real time data since Q1 1994, we compute inflation rates from ex-post data for the previous period. We compute the yoy (log) real money growth by substracting the (log) yoy inflation rate from the (log) nominal money growth. The IP, CPI, and M2 are published by the releasing institutions on a monthly basis in the middle of the subsequent month. As a consequence, we consider the values for December, March, June, and September, respectively. As only the releases in February, May, August and November for the CPI and the money stock are available in the real time data set of the Federal Reserve Bank of Philadelphia, we rely on revised data for the first month of a quarter for these two variables. GDP is released in the second month of a quarter for the preceding quarter. Accordingly, the information set includes the GDP figure of the third quarter at the end of January, of the fourth quarter at the end of April, of the first quarter at the end of July, and of the second quarter at the end of October.

A.2 Construction of Bond Factors and Excess Returns

Level, slope, and curvature. Diebold and Li (2006) demonstrate that the three time varying parameters of an exponential components framework are suitable to represent the yield curve factors "level", "slope", and "curvature". This method allows us to estimate precise yield factors for each period without making use of data beyond the forecasters' information set. We compute these factors based on a monthly series of bond yields for different maturities (last trading days in the months). Note that unlike Diebold and Li (2006), who model unsmoothed Fama-Bliss bond yields, we estimate the loading factors for the maturities of 1,2,3...10 years based on the smoothed data from Gürkaynak, Sack, and Wright (2007). A comparison of our measures for level, slope, curvature, and those of Diebold and Li (2006) for the period 1971/01 to 2000/12 yields a correlation coefficient of 0.99 (level), 0.99 (slope) and 0.73 (curvature). Note that the "slope factor" from this procedure has been shown to be almost perfectly negatively correlated with an empirical slope factor (defined as the ten-year yield minus the three-month yield), such that it is high when short rates exceed long rates. To make our results more easily interpretable on conventional grounds, we multiply the slope factor with minus one so that high values indicate a steep yield curve and vice versa.

Cochrane-Piazzesi factor. We compute a monthly series of the excess return forecasting factors put forth by Cochrane and Piazzesi (2005) (the "CP-Factors") by a recursive strategy as follows: First, we transform the monthly series of bond yields into prices, forward rates and excess returns.

To avoid multicollinearity in our regression of average excess returns on forward rates, we only keep the one, three and five-year forward rates on the RHS (following an approach proposed in Cochrane and Piazzesi (2008) to work with the smoothed bond yields in the data of Gürkaynak, Sack, and Wright (2007)). We ensure a real-time computation (avoiding potential "look-ahead bias") of the CP-Factors by rolling a 10-year estimation window forward. The period 01/1965 to 12/1974 serves as our initialization period. Afterwards, the CP-factor is estimated recursively. As a consequence, for example, the forward curve information from 01/1974 is only included in the estimation of the CP-Factor from 01/1974 to 01/1984.

Excess Returns. We obtain monthly series of excess returns of holding a bond with 12, 24, 36, 48, 60 and (smaller than) 120 months to maturity by taking the difference between the monthly return series from CRSP data and the return of a risk free asset (1 month T-bill) from Kenneth French's database. Quarterly return series and series at lower frequencies are constructed from these monthly time series.

A.3 Econometric Panel Approach

As mentioned in Section 4.2, we estimate panel regression with both endogenous and exogenous variables on the right-hand side of the equation, so that our general specification in Eq. (10) reads

$$e_{i,t} = a_1 e_{i,t-1} + \Xi_{i,t}\gamma + \Psi_t\delta + Z_t\beta + \epsilon_{i,t};$$

we refer to the main text for notation. We specify the error term as $\epsilon_{i,t} = \alpha_i + \mu_{i,t}$, which takes into account that forecasters' expectations may exhibit unobserved heterogeneity (in a fixed-effects panel regression setting).

As the unobserved component α_i is correlated with the lagged dependent variable, OLS would deliver inconsistent estimates. In the dynamic panel structure with a lagged dependent variable on the RHS, a fixed effects estimator is not appropriate either, as the differenced equation includes $\Delta e_{i,t-1} = e_{i,t-1} - e_{i,t-2}$ as a regressor, which is by construction correlated with the error term $\Delta\mu_t = \mu_{i,t} - \mu_{i,t-1}$. To circumvent these problems, Arellano and Bond (1991) propose the moment conditions with respect to the differenced equation

$$E\left[e_{i,t-s}(\mu_{i,t} - \mu_{i,t-1})\right] = 0 \tag{A.1}$$

for $s \geq 2$ and $t = 3, ..., T$. To avoid potential problems caused by weak instruments and in order to improve efficiency, System GMM includes both the differenced as well as the additional orthogonality conditions for the errors in the level equation

$$E\left[\Delta e_{i,t-s}\epsilon_{i,t}\right] = 0 \tag{A.2}$$

for $s = 1$ and $t = 4, ..., T$ (e.g., Blundell and Bond (1998)). System GMM Dynamic Panel Approaches are frequently applied to datasets in which the time series dimension T is small. As our T is rather large (albeit smaller than the cross-sectional dimension N), the conventional System GMM approach generates too many instruments relative to N, which may cause Hansen's J statistics to underreject (Anatolyev and Gospodinov, 2010). To address this problem, we collapse the moment conditions shown in Equations (A.1) and (A.3) by addition into smaller subsets.[23] Intuitively, this treats each moment condition to apply to all available periods instead of to each particular point in time individually, such that the moment conditions in Equation (A.1) are generated for $s \geq 2$ (instead of for $s \geq 2$ and $t = 3, ..., T$). As described by Cameron and Trivedi (2005, p. 765), we also construct the instruments from the *exogenous* variables Z_t and Ψ_t to

$$\begin{aligned} E\left[\Delta Z_{i,t}(\mu_{i,t} - \mu_{i,t-1})\right] &= 0 \\ E\left[Z_{i,t}\epsilon_{i,t}\right] &= 0. \end{aligned} \tag{A.3}$$

For the *endogenous* variables, we limit the collapsed System GMM-style instruments

$$E\left[X_{i,t-s}(\mu_{i,t} - \mu_{i,t-1})\right] = 0 \tag{A.4}$$

to the second and third lags values ($s = 2, 3$) in the differenced equation, as well as

$$E\left[\Delta e_{i,t-1}\epsilon_{i,t}\right] = 0 \tag{A.5}$$

for the equation in levels. To rely on efficient estimates when errors exhibit heteroskedasticity, we report the results from two-step GMM. As this methodology may deliver downward biased standard errors in small samples, we apply the correction suggested by Windmeijer (2005) to obtain accurate inference.

[23] For more details on this approach, see Roodman (2009).

A.4 Hodrick Standard Errors

We briefly review the construction of Hodrick (1992) standard errors used in our predictive regressions. Denote the vector of regression coefficients in Eq. (11) as $\phi_h = (\alpha_h \beta_h')'$ and the RHS variables as $x_t = (1, z_t')'$. The asymptotic distribution of ϕ_h when using GMM (Hansen, 1982) is $\sqrt{T}(\widehat{\phi}_h - \phi_h) \sim \mathcal{N}(0, \Omega)$, where Ω is given by $\Omega = Z_0^{-1} S_0 Z_0^{-1}$ and $Z_0 = E(x_t x_t')$. The idea of Hodrick's estimator is to exploit covariance stationarity and, hence, to sum the the explanatory variables into the past instead of summing residuals into the future. To this end, let

$$wk_t = e_{t+1} \left(\sum_{i=0}^{k-1} x_{t-i} \right) \tag{A.6}$$

where under the null hypothesis $\varepsilon_{t+h} = e_{t+1} + \ldots + e_{t+h}$, so that e_{t+1} denotes the one-step ahead forecast error. Estimates of e_{t+1} are obtained as the residual of a regression of returns on a constant. Finally, the spectral density S_0 is estimated as

$$\widehat{S}_0 = \frac{1}{T} \sum_{t=k}^{T} wk_t wk_t' \tag{A.7}$$

so that an estimate of Ω can be computed.

Table 1: Descriptive statistics: Risk premia

This table reports descriptive statistics for expected and realized changes in bond risk premia (Panel A and Panel B, respectively). Numbers in brackets are t-statistics for the means and are based on Newey-West HAC standard errors. AC(1) debotes first-order autocorrelation and numbers in parentheses are p-values for the test of no autocorrelation (based on the Ljung-Box Q statistic). h denotes the horizon and ranges from one to four quarters ahead.

	Expected changes				Realized changes			
	$h=1$	$h=2$	$h=3$	$h=4$	$h=1$	$h=2$	$h=3$	$h=4$
Mean	-2.12	-2.03	-1.99	-2.28	-1.52	-3.07	-4.46	-5.83
t-stat.	[-3.27]	[-2.82]	[-2.48]	[-2.75]	[-2.79]	[-2.97]	[-3.13]	[-3.37]
Median	-1.75	-2.04	-1.96	-2.30	-1.72	-3.94	-4.49	-6.98
Stand. Dev.	0.95	1.05	1.17	1.20	1.17	1.84	2.28	2.66
Skewness	-0.64	-0.37	-0.26	-0.04	0.37	0.40	0.44	0.39
Kurtosis	3.75	3.48	3.53	3.48	2.77	2.48	2.83	2.78
AC(1)	0.69	0.69	0.69	0.69	0.21	0.57	0.73	0.73
p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.21)	(0.00)	(0.00)	(0.00)

Table 2: Determinants of expected bond risk premia

This table reports panel regression estimates where individual risk premium expectations are regressed on the lagged endogeneous variable ($E_{t-1,i}[\Delta\pi_{t-1+h}]$), and macro expectations: expected NGDP growth ($E_{t,i}[\Delta\text{NGDP}]$), expected RGDP growth ($E_{t,i}[\Delta\text{RGDP}]$) and expected inflation ($E_{t,i}[\Delta\text{INF}]$) over the next quarter. In addition, we present results for aggregate uncertainty about GDP growth ($\Psi(\text{RGDP}_{TY,NY})$) and inflation rates ($\Psi(\text{INF}_{TY,NY})$), where TY or NY denote uncertainty about this year or next year, respectively. $\Psi(\text{INF}_{NY})^{\perp}$ denotes inflation uncertainty orthogonalized with respect to GDP uncertainty. R^2_{COR} denotes a Pseudo-R^2, J denotes Hansen's J-statistic, "Test $\Delta\epsilon_t$ for AR(2)" shows the test for second-order residual autocorrelation, # Instr. denotes the total number of instruments used, N shows the total number of cross-sectional units, whereas NT denotes the total number of observations. Jackknifed standard errors are provided in parentheses. Asterisks denote the level of significance, ***: 0.01, **: 0.05, *: 0.10.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
$E_{t-1,i}[\Delta\pi_{t-1+h}]$	0.266	0.375	0.424	0.428	0.425	0.429	0.251	0.250	0.257
	***(0.075)	***(0.073)	***(0.064)	***(0.064)	***(0.063)	***(0.064)	***(0.077)	***(0.077)	***(0.076)
$E_{t,i}[\Delta\text{RGDP}]$	0.512						0.444	0.482	0.454
	***(0.137)						***(0.165)	***(0.160)	***(0.166)
$E_{t,i}[\text{INF}]$		0.135					0.051	0.039	0.044
		**(0.058)					(0.064)	(0.064)	(0.065)
$\Psi(\text{RGDP}_{TY})$			-0.032						
			(0.049)						
$\Psi(\text{RGDP}_{NY})$				0.249			0.183		0.163
				***(0.046)			***(0.055)		***(0.058)
$\Psi(\text{INF}_{TY})$					0.167			0.238	
					**(0.065)			***(0.061)	
$\Psi(\text{INF}_{NY})$						0.192			
						***(0.063)			
$\Psi(\text{INF}_{NY})^{\perp}$									0.179
									**(0.090)
const.	-0.430	-0.437	-0.089	-0.087	-0.089	-0.088	-0.519	-0.514	-0.509
	***(0.091)	***(0.152)	**(0.013)	***(0.013)	***(0.013)	***(0.013)	***(0.133)	***(0.133)	***(0.133)
R^2_{COR}	0.36	0.29	0.34	0.34	0.34	0.34	0.37	0.37	0.37
$J-$Stat.	64.85	62.63	67.46	62.27	63.83	63.26	64.66	65.38	65.66
df	70	70	68	68	68	68	72	72	72
p-value	(0.65)	(0.72)	(0.50)	(0.67)	(0.62)	(0.64)	(0.72)	(0.70)	(0.69)
Test $\Delta\epsilon_t$ for AR(2)	1.570	0.675	-0.012	0.598	0.082	0.187	1.948	1.851	1.98
p-value	(0.12)	(0.50)	(0.99)	(0.55)	(0.94)	(0.85)	(0.05)	(0.06)	(0.05)
# Instr.	73	73	71	71	71	71	77	77	78
N	116	114	126	126	126	126	114	114	114
T	1,639	1,575	1,999	1,999	1,999	1,999	1553	1553	1,553

Table 3: Combining macro expectations, uncertainty and bond factors

This table reports panel regression results where expected risk premium changes are regressed on standard yield curve factors (level, slope, and curvature) and the bond forecasting factor of Cochrane and Piazzesi (2005), denoted CP. Jackknifed standard errors are provided in parentheses. Asterisks denote the level of significance, ***: 0.01, **: 0.05, *: 0.10.

	(i)	(ii)	(iii)	(iv)	(v)
$E_{t-1,i}[\Delta\pi_{t-1+h}]$	0.264	0.207	0.228	0.262	0.234
	***(0.078)	***(0.075)	***(0.084)	***(0.081)	***(0.083)
$E_{t,i}[\Delta\text{RGDP}]$	0.444	0.428	0.300	0.448	0.313
	***(0.144)	***(0.156)	*(0.169)	***(0.169)	**(0.159)
$E_{t,i}[\text{INF}]$	0.071	0.025	-0.009	0.036	0.019
	(0.055)	(0.059)	(0.063)	(0.064)	(0.056)
$\Psi(\text{RGDP}_{NY})$	0.095	0.083	0.102	0.169	0.045
	(0.089)	(0.122)	(0.142)	*(0.098)	(0.186)
$\Psi(\text{INF}_{NY})^{\perp}$	-0.014	0.076	0.306	0.120	0.096
	(0.095)	(0.120)	**(0.120)	(0.101)	(0.143)
Level	-0.117				-0.083
	***(0.038)				***(0.031)
Slope		0.077			0.025
		***(0.011)			(0.024)
Curvature			0.051		0.037
			***(0.017)		***(0.013)
CP				-0.023	
				*(0.013)	
const.	0.134	-0.308	-0.136	-0.506	0.295
	(0.239)	**(0.126)	(0.205)	***(0.138)	(0.243)
R^2_{COR}	0.43	0.47	0.45	0.38	0.51
$J-$Stat.	66.34	65.54	62.82	66.72	61.72
df	72	72	72	72	72
p-value	(0.67)	(0.69)	(0.77)	(0.65)	(0.80)
Test $\Delta\epsilon_t$ for AR(2)	1.524	1.469	1.034	1.942	0.943
p-value	(0.13)	(0.14)	(0.30)	(0.05)	(0.35)
# Instr.	79	79	79	79	81
N	114	114	114	114	114
NT	1,553	1,553	1,553	1,553	1,553

Table 4: Combining macro expectations, uncertainty, and real-time macro factors

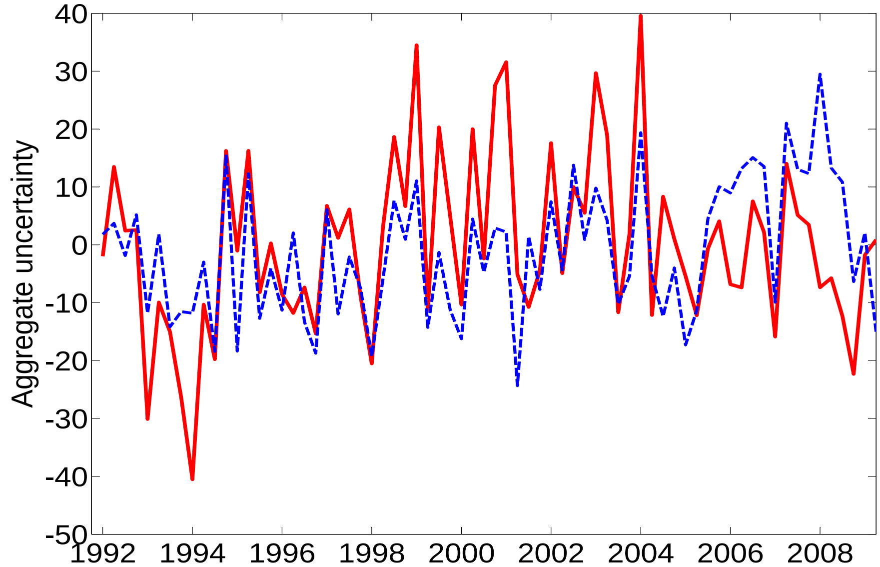
This table reports panel regression results where expected risk premium changes are regressed on lagged macro expectations, macro uncertainty, and real-time macro factors. As additional macro factors we consider growth rates in CPI inflation (Δ CPI), Industrial Production (Δ IP), GDP (Δ GDP), and M2 (Δ M2). Jackknifed standard errors are provided in parentheses. Asterisks denote the level of significance, ***: 0.01, **: 0.05, *: 0.10.

	(i)	(ii)	(iii)	(iv)	(v)
$E_{t-1,i}[\Delta\pi_{t-1+h}]$	0.263	0.211	0.227	0.249	0.217
	***(0.083)	**(0.100)	***(0.086)	***(0.082)	**(0.086)
$E_{t,i}[\Delta\text{RGDP}]$	0.451	0.411	0.433	0.460	0.368
	**(0.176)	**(0.176)	***(0.165)	**(0.189)	**(0.176)
$E_{t,i}[\text{INF}]$	0.062	0.014	0.015	0.046	0.033
	(0.069)	(0.069)	(0.063)	(0.068)	(0.068)
$\Psi(\text{RGDP}_{TY})$	0.121	0.151	0.107	0.147	0.115
	(0.138)	**(0.070)	(0.080)	(0.164)	(0.098)
$\Psi(\text{INF}_{TY})$	0.229	0.129	0.190	0.155	0.213
	**(0.116)	(0.108)	(0.119)	(0.136)	(0.154)
Δ CPI	-0.023				-0.042
	(0.017)				**(0.019)
Δ IP		0.021			0.025
		***(0.007)			***(0.007)
Δ GDP			0.053		
			***(0.018)		
Δ M2				-0.002	
				(0.011)	
const.	-0.487	-0.455	-0.584	-0.509	-0.369
	***(0139)	***(0.139)	***(0.134)	***(0.172)	***(0.137)
R^2_{COR}	0.37	0.39	0.40	0.37	0.41
$J-$Stat.	62.40	66.19	67.30	68.71	62.71
df	72	72	72	72	72
p-value	(0.78)	(0.67)	(0.64)	(0.59)	(0.77)
Test $\Delta\epsilon_t$ for AR(2)	1.837	1.39	1.56	1.856	1.26
p-value	(0.07)	(0.17)	(0.12)	(0.06)	(0.21)
# Instr.	79	79	79	79	80
N	114	114	114	114	114
NT	1,553	1,553	1,553	1,553	1,553

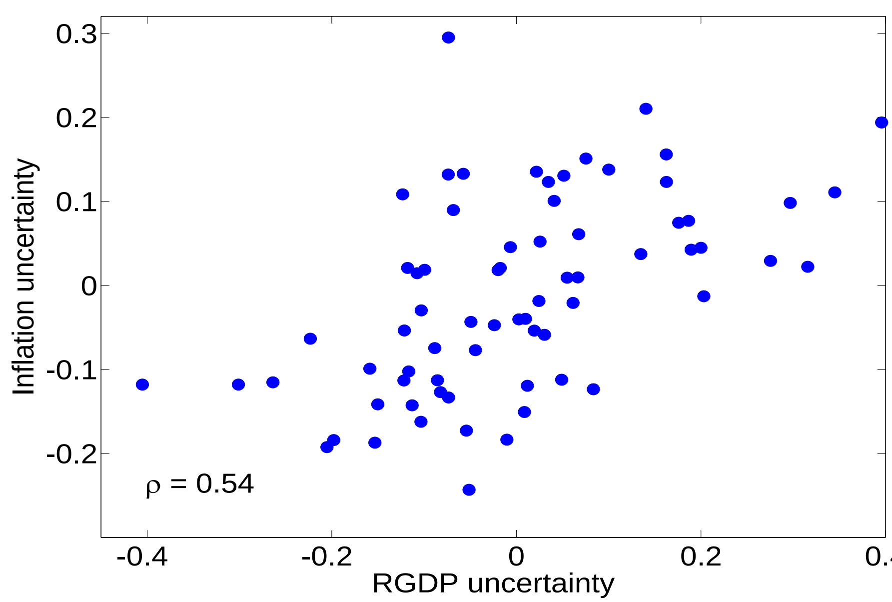
Table 5: Predictive Regressions

This table reports predictive regressions of future bond excess returns $rx(m)$ on our proxy for expected term premium changes $E_t[\Delta\pi_{t+h}]$. Excess returns are based on CRSP bond returns for maturities of $m = 1, \ldots, 5, 10$ years and the average return over all maturities minus the return to holding a three month T-bill. Panels A – D show results for forecast horizons h of one to four quarters and we match forecast horizons with the horizon of our proxy for expected term premia. We report t-statistics based on Newey-West (1987) standard errors (t_{NW}) as well as based on Hodrick (1992) standard errors (t_H).

	$rx(avg)$	$rx(1Y)$	$rx(2Y)$	$rx(3Y)$	$rx(4Y)$	$rx(5Y)$	$rx(10Y)$
Panel A: Forecast horizon $h = 1$ quarter							
const.	0.25	0.09	0.14	0.21	0.29	0.33	0.46
t_{NW}	[1.19]	[2.63]	[1.27]	[1.12]	[1.14]	[1.05]	[1.20]
t_H	[1.33]	[3.01]	[1.43]	[1.25]	[1.26]	[1.15]	[1.32]
$E_t[\Delta\pi_{t+1}]$	-1.09	-0.19	-0.77	-1.20	-1.47	-1.60	-1.33
t_{NW}	[-1.38]	[-1.53]	[-1.72]	[-1.60]	[-1.50]	[-1.36]	[-1.00]
t_H	[-1.32]	[-1.53]	[-1.65]	[-1.52]	[-1.42]	[-1.27]	[-0.98]
R^2	0.02	0.04	0.04	0.03	0.02	0.01	0.00
Panel B: Forecast horizon $h = 2$ quarters							
const.	0.53	0.17	0.31	0.48	0.63	0.69	0.91
t_{NW}	[1.54]	[3.02]	[1.66]	[1.52]	[1.51]	[1.37]	[1.47]
t_H	[1.52]	[3.40]	[1.75]	[1.54]	[1.48]	[1.30]	[1.42]
$E_t[\Delta\pi_{t+1}]$	-1.96	-0.38	-1.29	-1.95	-2.53	-2.91	-2.70
t_{NW}	[-1.91]	[-2.22]	[-2.18]	[-2.02]	[-1.99]	[-1.90]	[-1.52]
t_H	[-1.57]	[-2.06]	[-1.94]	[-1.69]	[-1.62]	[-1.50]	[-1.28]
R^2	0.05	0.10	0.08	0.06	0.06	0.05	0.02
Panel C: Forecast horizon $h = 3$ quarters							
const.	0.82	0.26	0.49	0.75	0.98	1.07	1.35
t_{NW}	[1.76]	[3.06]	[1.74]	[1.67]	[1.72]	[1.59]	[1.70]
t_H	[1.60]	[3.58]	[1.86]	[1.65]	[1.57]	[1.38]	[1.45]
$E_t[\Delta\pi_{t+1}]$	-2.31	-0.49	-1.51	-2.20	-2.87	-3.34	-3.43
t_{NW}	[-1.98]	[-2.57]	[-2.26]	[-1.98]	[-1.98]	[-1.93]	[-1.71]
t_H	[-1.59]	[-2.25]	[-2.00]	[-1.69]	[-1.61]	[-1.51]	[-1.35]
R^2	0.06	0.13	0.09	0.06	0.06	0.05	0.04
Panel D: Forecast horizon $h = 4$ quarters							
const.	0.86	0.31	0.53	0.80	1.04	1.11	1.38
t_{NW}	[1.62]	[2.93]	[1.51]	[1.47]	[1.54]	[1.42]	[1.64]
t_H	[1.24]	[3.09]	[1.49]	[1.29]	[1.22]	[1.04]	[1.10]
$E_t[\Delta\pi_{t+1}]$	-3.63	-0.73	-2.22	-3.36	-4.43	-5.23	-5.80
t_{NW}	[-3.17]	[-3.65]	[-3.17]	[-2.95]	[-3.07]	[-3.11]	[-3.10]
t_H	[-2.05]	[-2.68]	[-2.39]	[-2.13]	[-2.06]	[-1.97]	[-1.82]
R^2	0.13	0.22	0.15	0.12	0.12	0.12	0.11



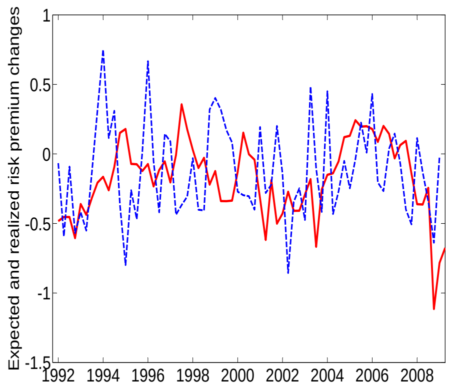
(a) Time-series of RGDP and Inflation uncertainty



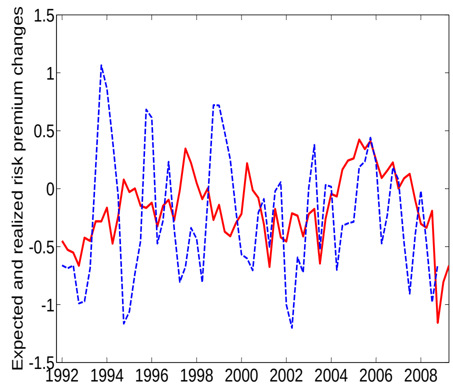
(b) Correlation of RGDP and Inflation uncertainty

Figure 1: Macro uncertainty

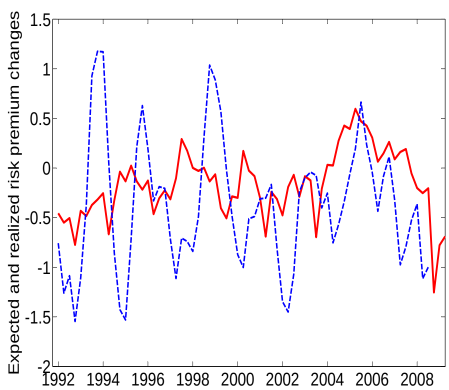
This figure shows plots of aggregate uncertainty about the following year's real gdp growth (blue, dashed line) and next year's inflation (red, solid line) in Panel (a) and cross-plots of the two series in Panel (b). ρ denotes the simple linear correlation coefficient between the two series.



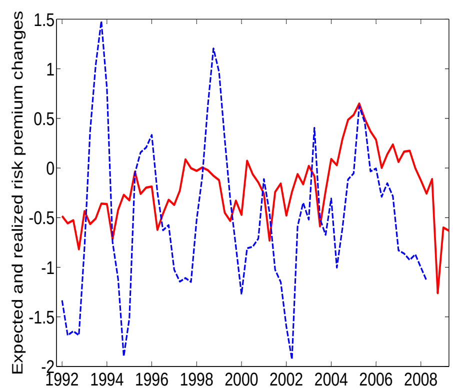
(a) $h = 1$ quarter



(b) $h = 2$ quarters



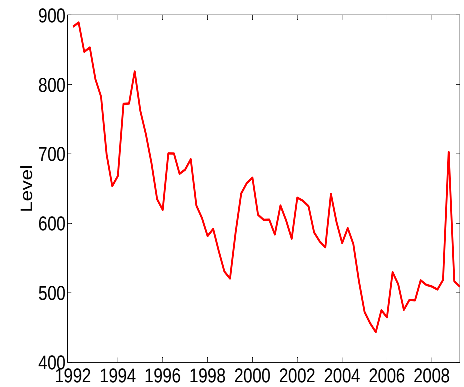
(c) $h = 3$ quarters



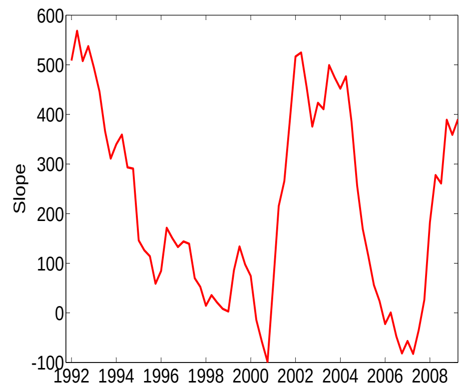
(d) $h = 4$ quarters

Figure 2: Expected and realized changes in term premia

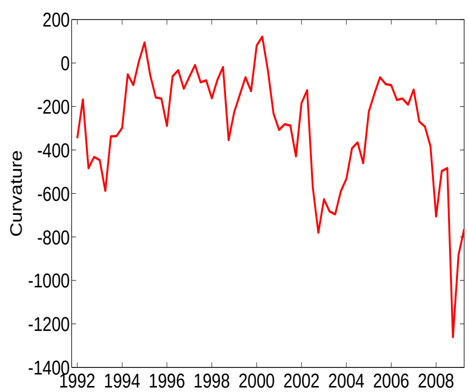
This figure shows plots of expected (red, solid line) and realized changes (blue, dashed line) in term premia over different horizons of $h = 1, 2, 3,$ and 4 quarters.



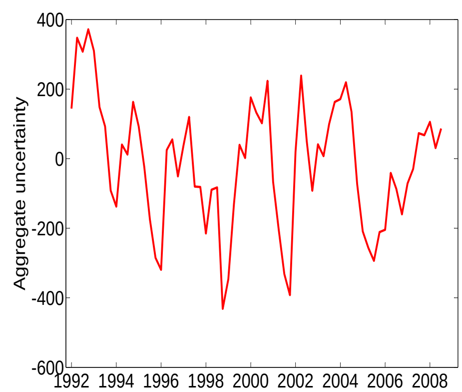
(a) Level factor



(b) Slope factor



(c) Curvature factor



(d) Cochrane-Piazzesi factor

Figure 3: Bond yield factors

This figure shows time-series plots of level, slope, and curvature based on Diebold and Li (2006) and the bond forecasting factor of Cochrane and Piazzesi (2005). Note that we have multiplied the slope factor with minus one so that higher readings of "slope" correspond to a steeper yield curve. The scaling of the graphs is in basis points.

Supplementary Appendix to accompany

Macro Expectations, Aggregate Uncertainty, and Expected Term Premia

Table A.I: Determinants of expected bond risk premia

The setup of this table is identical to table 2, but we include an NBER recession dummy. Jackknifed standard errors are provided in parentheses. Asterisks denote the level of significance, ***: 0.01, **: 0.05, *: 0.10.

	(i)	(ii)	(iii)	(iv)	(v)
$E_{t-1,i}[\Delta\pi_{t-1+h}]$	0.332	0.225	0.235	0.233	0.241
	***(0.066)	***(0.087)	***(0.078)	***(0.081)	***(0.080)
$E_{t,i}[\Delta\text{RGDP}]$		0.428	0.411	0.449	0.425
		**(0.199)	**(0.200)	**(0.199)	**(0.206)
$E_{t,i}[\text{INF}]$		0.042	0.047	0.036	0.041
		(0.064)	(0.065)	(0.064)	(0.065)
$\Psi(\text{RGDP}_{NY})$			0.162		0.146
			***(0.056)		**(0.067)
$\Psi(\text{INF}_{NY})$				0.213	
				***(0.076)	
$\Psi(\text{INF}_{NY})^{\perp}$					0.163
					(0.107)
Recession	-0.273	-0.090	-0.079	-0.071	-0.070
	***(0.033)	(0.078)	(0.076)	(0.079)	(0.078)
const.	-0.071	-0.479	-0.478	-0.480	-0.476
	***(0.015)	***(0.147)	***(0.145)	***(0.148)	***(0.145)
R^2_{COR}	0.38	0.37	0.37	0.37	0.38
$J-$Stat.	62.04	65.85	65.40	65.99	66.61
df	68	72	72	72	72
p-value	(0.68)	(0.68)	(0.70)	(0.68)	(0.66)
Test $\Delta\epsilon_t$ for AR(2)	-1.578	0.992	1.432	1.421	1.530
p-value	(0.12)	(0.32)	(0.15)	(0.16)	(0.13)
# Instr.	71	77	78	78	79
N	126	114	114	114	114
NT	1,999	1,553	1,553	1,553	1,553

Table A.II: Determinants of expected bond risk premia, $h = 4$

The setup of this table is identical to table 2 but here we investigate expectations for four quarters ahead, i.e. $h = 4$. Jackknifed standard errors are provided in parentheses. Asterisks denote the level of significance, ***: 0.01, **: 0.05, *: 0.10.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
$E_{t-1,i}[\Delta\pi_{t-1+h}]$	0.343	0.418	0.443	0.44	0.452	0.452	0.346	0.354	0.356
	***(0.083)	***(0.096)	***(0.073)	***(0.073)	***(0.071)	***(0.072)	***(0.089)	***(0.087)	***(0.086)
$E_{t,i}[\Delta\text{RGDP}]$	0.165						0.137	0.164	0.144
	**(0.070)						*(0.079)	**(0.076)	*(0.080)
$E_{t,i}[\text{INF}]$		0.113					0.019	-0.002	0.010
		(0.153)					(0.126)	(0.125)	(0.126)
$\Psi(\text{RGDP}_{TY})$			0.098						
			(0.071)						
$\Psi(\text{RGDP}_{NY})$				0.392			0.360		0.325
				***(0.061)			***(0.093)		***(0.095)
$\Psi(\text{INF}_{TY})$					0.407			0.413	
					***(0.098)			***(0.102)	
$\Psi(\text{INF}_{NY})$						0.400			
						***(0.084)			
$\Psi(\text{INF}_{NY})$									0.267
									**(0.125)
const.	-0.546	-0.391	-0.093	-0.093	-0.092	-0.091	-0.522	-0.540	-0.519
	***(0.194)	***(0.409)	***(0.016)	***(0.016)	***(0.015)	***(0.015)	(0.323)	*(0.322)	(0.323)
R^2_{COR}	0.47	0.45	0.48	0.48	0.47	0.48	0.49	0.48	0.49
$J-$Stat.	61.11	62.36	64.05	61.76	62.97	63.05	62.86	62.36	63.02
df	70	70	68	68	68	68	72	72	72
p-value	(0.77)	(0.73)	(0.61)	(0.69)	(0.65)	(0.65)	(0.77)	(0.78)	(0.77)
Test $\Delta\epsilon_t$ for AR(2)	0.922	0.331	0.951	1.331	0.912	1.073	1.246	1.119	1.300
p-value	(0.36)	(0.74)	(0.34)	(0.18)	(0.36)	(0.28)	(0.21)	(0.26)	(0.19)
# Instr.	73	73	71	71	71	71	77	77	78
N	113	112	124	124	124	124	111	111	111
T	1,471	1,432	1,847	1,847	1,847	1,847	1,409	1,409	1,409

Table A.III: Determinants of expected bond risk premia, alternative proxy

The setup of this table is identical to table 2 but here we construct our proxy for expected change in risk premia without the difference part of short term interest rates (i.e. we keep the expected change of long yields on the RHS). Jackknifed standard errors are provided in parentheses. Asterisks denote the level of significance, ***: 0.01, **: 0.05, *: 0.10.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
$E_{t-1,i}[\Delta\pi_{t-1+h}]$	0.248	0.354	0.403	0.408	0.405	0.408	0.233	0.232	0.239
	***(0.075)	***(0.075)	***(0.067)	***(0.066)	***(0.066)	***(0.066)	***(0.076)	***(0.075)	***(0.075)
$E_{t,i}[\Delta\text{RGDP}]$	0.497						0.432	0.466	0.443
	***(0.134)						***(0.161)	***(0.155)	***(0.162)
$E_{t,i}[\text{INF}]$		0.129					0.045	0.034	0.038
		**(0.058)					(0.064)	(0.063)	(0.064)
$\Psi(\text{RGDP}_{TY})$			-0.022						
			(0.049)						
$\Psi(\text{RGDP}_{NY})$				0.236			0.166		0.146
				***(0.046)			***(0.054)		**(0.057)
$\Psi(\text{INF}_{TY})$					0.171			0.225	
					***(0.064)			***(0.060)	
$\Psi(\text{INF}_{NY})$						0.191			
						***(0.062)			
$\Psi(\text{INF}_{NY})$									0.178
									**(0.087)
const.	-0.373	-0.382	-0.052	-0.050	-0.052	-0.051	-0.448	-0.442	-0.439
	***(0.087)	**(0.150)	***(0.009)	***(0.009)	***(0.009)	***(0.009)	***(0.129)	***(0.128)	***(0.128)
R^2_{COR}	0.34	0.26	0.30	0.31	0.30	0.30	0.34	0.34	0.35
$J-$Stat.	64.21	62.39	67.32	62.85	64.62	64	65.21	62.65	62.10
df	70	70	68	68	68	68	72	72	72
p-value	(0.67)	(0.73)	(0.50)	(0.65)	(0.59)	(0.62)	(0.70)	(0.78)	(0.79)
Test $\Delta\epsilon_t$ for AR(2)	1.471	0.659	0.012	0.608	0.11	0.218	1.849	1.770	1.882
p-value	(0.14)	(0.51)	(0.99)	(0.54)	(0.92)	(0.83)	(0.06)	(0.08)	(0.06)
# Instr.	73	73	71	71	71	71	77	77	78
N	116	114	126	126	126	126	114	114	114
T	1,639	1,575	1,999	1,999	1,999	1,999	1553	1553	1,553

Table A.IV: Determinants of expected bond risk premia, proxy based on 7-year duration bonds

The setup of this table is identical to table 2 but here we construct our proxy for expected change in risk premia with the current yield of a 7-year-zero-coupon bond (instead of a 10 year bond). Jackknifed standard errors are provided in parentheses. Asterisks denote the level of significance, ***: 0.01, **: 0.05, *: 0.10.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
$E_{t-1,i}[\Delta\pi_{t-1+h}]$	0.226	0.273	0.290	0.289	0.295	0.291	0.251	0.217	0.222
	***(0.072)	***(0.082)	***(0.080)	***(0.080)	***(0.082)	***(0.081)	***(0.073)	***(0.074)	***(0.074)
$E_{t,i}[\Delta\text{RGDP}]$	0.319						0.299	0.310	0.308
	***(0.115)						**(0.143)	**(0.138)	**(0.143)
$E_{t,i}[\text{INF}]$		0.082					0.009	0.001	-0.001
		(0.052)					(0.062)	(0.060)	(0.062)
$\Psi(\text{RGDP}_{TY})$			-0.007						
			(0.047)						
$\Psi(\text{RGDP}_{NY})$				0.127			0.078		0.047
				***(0.042)			(0.051)		(0.053)
$\Psi(\text{INF}_{TY})$					0.292			0.238	
					***(0.067)			***(0.057)	
$\Psi(\text{INF}_{NY})$						0.239			
						***(0.056)			
$\Psi(\text{INF}_{NY})$									0.299
									***(0.081)
const.	-0.054	-0.073	0.128	0.128	0.126	0.127	-0.065	-0.051	-0.050
	(0.073)	(0.131)	***(0.016)	***(0.016)	***(0.016)	***(0.016)	(0.130)	(0.120)	(0.120)
R^2_{COR}	0.22	0.15	0.22	0.22	0.22	0.22	0.21	0.22	0.23
$J-$Stat.	67.48	62.60	64.45	61.96	60.07	60.81	68.45	71.83	70.20
df	70	70	68	68	68	68	72	72	72
p-value	(0.56)	(0.72)	(0.60)	(0.68)	(0.74)	(0.72)	(0.60)	(0.48)	(0.54)
Test $\Delta\epsilon_t$ for AR(2)	0.533	0.49	0.261	0.644	0.622	0.621	0.890	1.056	0.97
p-value	(0.59)	(0.62)	(0.79)	(0.52)	(0.53)	(0.54)	(0.37)	(0.29)	(0.33)
# Instr.	73	73	71	71	71	71	77	77	78
N	116	114	124	124	124	124	114	114	114
T	1,595	1,531	1,950	1,950	1,950	1,950	1,509	1,509	1,509

Table A.V: Predictive Regressions with the CP factor

This table reports predictive regressions of future bond excess returns $rx(m)$ on the bond forecasting factor by Cochrane and Piazzesi (2005). The setup is identical to that of Table 5.

	$rx(avg)$	$rx(1Y)$	$rx(2Y)$	$rx(3Y)$	$rx(4Y)$	$rx(5Y)$	$rx(10Y)$
Panel A: Forecast horizon $h = 1$ quarter							
const.	0.48	0.12	0.28	0.44	0.58	0.66	0.77
t_{NW}	[2.84]	[4.64]	[2.98]	[2.76]	[2.76]	[2.59]	[2.75]
t_H	[2.55]	[4.80]	[2.92]	[2.58]	[2.49]	[2.27]	[2.39]
CP	0.00	0.00	0.00	0.00	0.00	0.01	0.01
t_{NW}	[4.74]	[2.62]	[3.51]	[4.18]	[4.60]	[4.83]	[5.34]
t_H	[3.08]	[2.36]	[2.80]	[2.93]	[3.02]	[3.04]	[3.21]
R^2	0.19	0.10	0.14	0.16	0.18	0.19	0.21
Panel B: Forecast horizon $h = 2$ quarters							
const.	0.90	0.24	0.53	0.83	1.09	1.23	1.46
t_{NW}	[2.84]	[4.42]	[2.83]	[2.68]	[2.74]	[2.63]	[2.84]
t_H	[2.47]	[4.81]	[2.87]	[2.51]	[2.42]	[2.19]	[2.31]
CP	0.00	0.00	0.00	0.00	0.01	0.01	0.01
t_{NW}	[4.05]	[1.93]	[2.76]	[3.46]	[3.97]	[4.36]	[4.59]
t_H	[2.50]	[1.70]	[2.18]	[2.31]	[2.41]	[2.45]	[2.73]
R^2	0.17	0.06	0.10	0.13	0.15	0.17	0.21
Panel C: Forecast horizon $h = 3$ quarters							
const.	1.25	0.34	0.75	1.15	1.51	1.70	2.03
t_{NW}	[2.62]	[4.07]	[2.54]	[2.42]	[2.50]	[2.41]	[2.69]
t_H	[2.41]	[4.95]	[2.84]	[2.45]	[2.35]	[2.11]	[2.23]
CP	0.01	0.00	0.00	0.00	0.01	0.01	0.01
t_{NW}	[2.57]	[1.58]	[1.89]	[2.18]	[2.40]	[2.60]	[3.13]
t_H	[2.34]	[1.79]	[2.11]	[2.18]	[2.23]	[2.23]	[2.57]
R^2	0.14	0.06	0.09	0.11	0.13	0.14	0.19
Panel D: Forecast horizon $h = 4$ quarters							
const.	1.63	0.45	0.99	1.51	1.97	2.22	2.64
t_{NW}	[2.54]	[3.83]	[2.39]	[2.31]	[2.41]	[2.35]	[2.71]
t_H	[2.39]	[4.97]	[2.83]	[2.43]	[2.33]	[2.10]	[2.19]
CP	0.01	0.00	0.00	0.00	0.01	0.01	0.01
t_{NW}	[1.87]	[1.38]	[1.45]	[1.57]	[1.70]	[1.82]	[2.35]
t_H	[1.90]	[1.70]	[1.76]	[1.75]	[1.78]	[1.79]	[2.11]
R^2	0.09	0.04	0.05	0.06	0.08	0.09	0.14